

Module Manual

Bachelor of Science

General Engineering Science (German program, 7 semester)

Cohort: Winter Term 2018

Updated: 28th September 2018

Table of Contents

| Table of Contents | 2 |
|---|------------|
| Program description | 6 |
| Core qualification | 9 |
| Module M0577: Nontechnical Complementary Courses for Bachelors | 9 |
| Module M0743: Electrical Engineering I: Direct Current Networks and Electromagnetic Fields | 11 |
| Module M0889: Mechanics I (Statics) | 13 |
| Module M0850: Mathematics I | 16 |
| Module M1315: Physics for Engineers (AIW) | 20 |
| Module M0687: Chemistry | 22 |
| Module M1121: Programming in C Module M0547: Electrical Engineering II: Alternating Current Networks and Basic Devices | 25 27 |
| Module M0594: Fundamentals of Mechanical Engineering Design | 30 |
| Module M0696: Mechanics II: Mechanics of Materials | 32 |
| Module M0671: Technical Thermodynamics I | 34 |
| Module M0851: Mathematics II | 37 |
| Module M0688: Technical Thermodynamics II | 41 |
| Module M0959: Mechanics III (Hydrostatics, Kinematics, Kinetics I) | 43 |
| Module M0853: Mathematics III | 45 |
| Module M1273: Advanced Internship GES | 49 |
| Specialization Civil Engineering | 50 |
| Module M0580: Principles of Building Materials and Building Physics | 50 |
| Module M0740: Structural Analysis I | 53 |
| Module M0590: Building Materials and Building Chemistry | 55 |
| Module M0706: Geotechnics I | 57 |
| Module M0613: Reinforced Concrete I | 59 |
| Module M0744: Structural Analysis II | 61 |
| Module M0611: Steel Structures I | 63 |
| Module M0728: Hydraulic Engineering I | 65 |
| Module M0833: Introduction to Control Systems | 68 |
| Module M0628: Water Management | 72 |
| Module M0730: Computer Engineering | 74 |
| Module M0631: Concrete Structures II | 77 |
| Module M0755: Geotechnics II | 79 |
| Module M0878: Applications in Civil and Environmental Engineering | 81 |
| Module M0829: Foundations of Management | 91 |
| Module M0579: Structural Design | 95 |
| Module M0686: Sanitary Engineering Module M0869: Hydraulic Engineering II | 99 102 |
| Specialization Bioprocess Engineering | 105 |
| Module M0886: Fundamentals of Process Engineering and Material Engineering | 105 |
| Module M0937: Physical Chemistry | 108 |
| Module M0730: Computer Engineering | 111 |
| Module M0536: Fundamentals of Fluid Mechanics | 114 |
| Module M0544: Phase Equilibria Thermodynamics | 117 |
| Module M0757: Biochemistry and Microbiology | 121 |
| Module M0672: Signals and Systems | 126 |
| Module M0938: Bioprocess Engineering - Fundamentals | 130 |
| Module M0538: Heat and Mass Transfer | 133 |
| Module M0546: Thermal Separation Processes | 136 |
| Module M0892: Chemical Reaction Engineering | 142 |
| Module M0945: Bioprocess Engineering - Advanced | 147 |
| Module M0833: Introduction to Control Systems | 150 |
| Module M1275: Environmental Technology | 154 |
| Module M0539: Process and Plant Engineering I | 156 |
| Module M0670: Particle Technology and Solids Process Engineering | 159 |
| Module M0829: Foundations of Management | 162 |
| Module M1274: Environmental Technology | 166 |
| Specialization Electrical Engineering | 169 |
| Module M0708: Electrical Engineering III: Circuit Theory and Transients | 169 |
| Module M0730: Computer Engineering | 172 |
| Module M0567: Theoretical Electrical Engineering I: Time-Independent Fields | 175 |
| Module M0672: Signals and Systems | 178 |
| Module M0748: Materials in Electrical Engineering | 182 |
| Module M0709: Electrical Engineering IV: Transmission Lines and Research Seminar | 186 |
| Module M0854: Mathematics IV | 188 |
| Module M0675: Introduction to Communications and Random Processes | 192 |
| Module M0568: Theoretical Electrical Engineering II: Time-Dependent Fields | 194 |
| Module M1235: Electrical Power Systems I | 197 |
| Module M0760: Electronic Devices Module M0783: Measurements: Methods and Data Processing | 200 |
| Module M0833: Measurements: Methods and Data Processing Module M0833: Introduction to Control Systems | 203 205 |
| modulo moddo. Introduction to Control Cystems | 203 |

| | Semiconductor Circuit Design | 209 |
|------------------------------|---|------------|
| | Foundations of Management | 212 |
| | Electrical Engineering Project Laboratory | 216 |
| | Energy and Environmental Engineering | 218 |
| | Computer Engineering Fundamentals of Materials Science | 218 222 |
| | : Mechanical Engineering: Design | 225 |
| | Fundamentals of Fluid Mechanics | 229 |
| | Electrical Machines | 232 |
| | Renewables and Energy Systems | 235 |
| | Heat and Mass Transfer | 238 |
| Module M0546 | : Thermal Separation Processes | 241 |
| | Gas and Steam Power Plants | 247 |
| | Measurement Technology for Mechanical and Process Engineers | 251 |
| | Environmental Technology | 256 |
| | : Introduction to Control Systems | 258 |
| | Particle Technology and Solids Process Engineering Environmental Technology | 262 265 |
| | Informatics for Process Engineers | 268 |
| | Process and Plant Engineering I | 271 |
| | Foundations of Management | 274 |
| Specialization | Computer Science | 278 |
| Module M0561 | : Discrete Algebraic Structures | 278 |
| Module M0730 | Computer Engineering | 280 |
| | Objectoriented Programming, Algorithms and Data Structures | 283 |
| | Signals and Systems | 285 |
| | Graph Theory and Optimization | 289 |
| Module M0727 | : Stochastics : Automata Theory and Formal Languages | 291 293 |
| | : Embedded Systems | 297 |
| | : Numerical Mathematics I | 299 |
| | Seminars Computer Science and Mathematics | 302 |
| Module M0834 | : Computernetworks and Internet Security | 304 |
| | Functional Programming | 306 |
| | Computer Architecture | 309 |
| | : Introduction to Control Systems | 311 |
| | : Computability and Complexity Theory : Foundations of Management | 315 317 |
| | Lab Cyber-Physical Systems | 321 |
| | Software Engineering | 323 |
| | Operating Systems | 325 |
| | Mathematical Statistics | 327 |
| | Mechanical Engineering | 329 |
| | Mechanical Engineering: Design | 329 |
| | : Fundamentals of Materials Science | 334 |
| | : Fluid Dynamics : Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) | 337 339 |
| | Magaurament Tachnology for Machanical and Process Engineers | 342 |
| | : Fundamentals of Production and Quality Management | 347 |
| | Electrical Machines | 349 |
| Module M0934 | : Advanced Materials | 352 |
| Focus Biomecl | | 354 |
| Module M0597 | Advanced Mechanical Engineering Design | 354 |
| Module M1277 | : MED I: Introduction to Anatomy | 360 |
| Module M0672 | Signals and Systems | 362 |
| Modulo M0720 | : MED I: Introduction to Radiology and Radiation Therapy : Computer Engineering | 366 369 |
| | : Computer Engineering : MED II: Introduction to Biochemistry and Molecular Biology | 369 |
| | Numerical Mathematica I | 374 |
| | Introduction to Control Systems | 377 |
| Module M1333 | : BIO I: Implants and Fracture Healing | 381 |
| | MED II: Introduction to Physiology | 383 |
| | Foundations of Management | 385 |
| | BIO I: Experimental Methods in Biomechanics | 389 |
| Focus Energy | | 391 |
| Module M0730 | Computer Engineering | 391 |
| Module M0672 Module M0684 | Signals and Systems | 395 399 |
| | Latro du ation to Control Systems | 401 |
| | : Advanced Mechanical Engineering Design | 405 |
| | : Computational Fluid Dynamics I | 411 |
| | Gas and Steam Power Plants | 413 |
| | Reciprocating Machinery | 417 |
| | Foundations of Management | 420 |
| IVIOUUIE IVIOT I 8 | : Renewables and Energy Systems | 424 |

| | Systems Engineering | 427 |
|----------------|--|------------|
| | Advanced Mechanical Engineering Design | 427 |
| | Signals and Systems | 433 |
| | Advanced Mechanical Design Project | 437 |
| | Simulation and Design of Mechatronic Systems Introduction to Control Systems | 439 441 |
| | Computer Engineering | 445 |
| | Integrated Product Development and Lightweight Design | 448 |
| | Aeronautical Systems | 451 |
| Module M0829: | Foundations of Management | 454 |
| Focus Material | s in Engineering Sciences | 458 |
| | Advanced Mechanical Engineering Design | 458 |
| | Signals and Systems | 464 |
| | Structural Materials | 468 |
| | Numerical Mathematics I Material Science Laboratory | 471 474 |
| | Introduction to Control Systems | 474 |
| | Computer Engineering | 480 |
| | Enhanced Fundamentals of Materials Science | 483 |
| | Foundations of Management | 487 |
| Focus Mechatr | onics | 491 |
| | Advanced Mechanical Engineering Design | 491 |
| | Signals and Systems | 497 |
| | Electrical Engineering III: Circuit Theory and Transients | 501 |
| | Simulation and Design of Mechatronic Systems | 503 |
| | Computer Engineering Introduction to Control Systems | 505 508 |
| | Semiconductor Circuit Design | 512 |
| | Mathematics IV | 515 |
| | Foundations of Management | 519 |
| Focus Product | Development and Production | 523 |
| Module M0597: | Advanced Mechanical Engineering Design | 523 |
| | Production Engineering | 529 |
| | Advanced Mechanical Design Project | 532 |
| | Production Technology | 534 |
| | Computer Engineering Introduction to Control Systems | 538 541 |
| | Integrated Product Development and Lightweight Design | 545 |
| | Enhanced Fundamentals of Materials Science | 548 |
| | Foundations of Management | 552 |
| Focus Theoreti | cal Mechanical Engineering | 556 |
| Module M0597: | Advanced Mechanical Engineering Design | 556 |
| | Signals and Systems | 562 |
| | Advanced Mechanical Design Project | 566 |
| Module M0684: | | 568 |
| | Computer Engineering Introduction to Control Systems | 570 573 |
| | Production Engineering | 577 |
| | Simulation and Design of Mechatronic Systems | 580 |
| | Mathematics IV | 582 |
| | Foundations of Management | 586 |
| | Biomedical Engineering | 590 |
| | Fundamentals of Materials Science | 590 |
| | Computer Engineering | 593 |
| | Fluid Dynamics | 596 |
| | Signals and Systems Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) | 598 602 |
| | MED I: Introduction to Anatomy | 605 |
| | MED I: Introduction to Radiology and Radiation Therapy | 607 |
| | Mechanical Engineering: Design | 610 |
| Module M0662: | Numerical Mathematics I | 614 |
| Module M0684: | Heat Transfer | 617 |
| | Measurement Technology for Mechanical and Process Engineers | 619 |
| | Introduction to Control Systems | 624 |
| | MED II: Introduction to Biochemistry and Molecular Biology | 628 |
| | BIO I: Implants and Fracture Healing Foundations of Management | 630 632 |
| | Introduction into Medical Technology and Systems | 636 |
| | MED II: Introduction to Physiology | 638 |
| | BIO I: Experimental Methods in Biomechanics | 640 |
| Specialization | Naval Architecture | 642 |
| | Introduction to Control Systems | 642 |
| | Computer Engineering | 647 |
| Module M0829: | Foundations of Management | 650 |

| Module M0854: Mathematics IV | 654 |
|---|-----|
| Module M0960: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) | 658 |
| Module M0680: Fluid Dynamics | 661 |
| Module M0640: Stochastics and Ship Dynamics | 663 |
| Module M0655: Computational Fluid Dynamics I | 666 |
| Module M0659: Fundamentals of Ship Structural Design and Analysis | 668 |
| Module M0664: Structural Design and Construction of Ships | 671 |
| Module M1109: Resistance and Propulsion | 674 |
| Module M1118: Hydrostatics and Body Plan | 676 |
| Module M0933: Fundamentals of Materials Science | 680 |
| Module M1110: Ship Design | 683 |
| Specialization Process Engineering | 685 |
| Module M0886: Fundamentals of Process Engineering and Material Engineering | 685 |
| Module M0937: Physical Chemistry | 688 |
| Module M0730: Computer Engineering | 691 |
| Module M0536: Fundamentals of Fluid Mechanics | 694 |
| Module M0544: Phase Equilibria Thermodynamics | 697 |
| Module M0672: Signals and Systems | 701 |
| Module M0938: Bioprocess Engineering - Fundamentals | 705 |
| Module M0538: Heat and Mass Transfer | 708 |
| Module M0546: Thermal Separation Processes | 711 |
| Module M0892: Chemical Reaction Engineering | 717 |
| Module M0956: Measurement Technology for Mechanical and Process Engineers | 722 |
| Module M0833: Introduction to Control Systems | 727 |
| Module M1275: Environmental Technology | 731 |
| Module M0539: Process and Plant Engineering I | 733 |
| Module M0670: Particle Technology and Solids Process Engineering | 736 |
| Module M0829: Foundations of Management | 739 |
| Module M0891: Informatics for Process Engineers | 743 |
| Module M1274: Environmental Technology | 746 |
| Thesis | 749 |
| Module M-001: Bachelor Thesis | 749 |
| | |





Module Manual

Bachelor

General Engineering Science (German program, 7 semester)

Cohort: Winter Term 2018

Updated: 28th September 2018

Program description

Content

The Bachelor-program General Engineering Science (GES) starts with a broad, for all students binding fundamental engineering curricula. With begin of the 3rd Semester students have to choose one of the 9 fields of study (civil engineering, biotechnology, electrical engineering, energy- and environmental engineering, computer science, mechanical



engineering, medical engineering, naval engineering, process engineering), some of them with further specialisations. GES has with 210 credit points a higher workload compared to other Bachelor study courses. Therefore General Engineering Science is designed for 7 semesters.

Career prospects

The graduates of the Bachelor program General Engineering Science are directly able to enter a career in the field of mechanical engineering, civil engineering, electrical engineering, process engineering or computer science engineering and work responsibly as engineer. They are entitled to use the professional title Ingenieurin or Ingenieur (Engineer) pursuant to the Engineers Acts (Ingenieurgesetzen) of the states in Germany.

Possible employers include companies in mechanical, civil, process, electrical and computer science engineering as well as engineering firms.

The Bachelor degree in one of the fields of study enables a consecutive study of one of the corresponding Master studies, of another technical or of an economic oriented Master study. Most of the modules in the 1st and the 2nd semester of GES are offered in English.

Learning target

Knowledge

Students can:

- Name and describe the mathematical and scientific principles and methods of the engineering sciences;
- Ellucidate the principles and methods of the engineering sciences and present an overview of their subject;
- Explain in detail the foundations, methods and areas of application of their specialization, and, as necessary, their particular focus;
- Recite the foundations and methods of the engineering sciences and provide an overview of the relevant social, ethical, ecological and economic marginal conditions of their subject.

Skills

Graduates are able to

- Identify and abstract subject-related problems fundamentally and solve them holistically
- Identify, combine and apply in an interdisciplinary manner the methods appropriate for the desired analysis, modeling, simulation and optimization
- Penetrate, analyze and evaluate products and methods from different branches of engineering on a systems technology basis
- Applofdesign methods from different branches of engineering
- Plan and carry out experiments and interpret the results
- · Assess the limits of techniques and methods
- Use their knowledge in an interdisciplinary manner and responsible way, taking economic requirements into consideration
- · Evaluate problems in a wider societal context and assess the non-technical repercussions of engineering.

Social Competence

Graduates are able to

- Present the methods and results of their work comprehensively both orally and in writing
- Communicate with experts and laypersons about the contents and problems of engineering



- · Respond appropriately to inquiries, additions and comments
- · Work in groups, define, allocate and integrate subtasks, reach agreement on schedules and to interact socially.

Autonomy

Graduates are able to

- Familiarize themselves with the relevant literature and effectively use databases and other digital sources of information as well as present the results of their work comprehensively both orally and in writing
- Assess their existing competences realistically and develop and carry out strategies for compensating any deficits they identify
- · Learn a range of subjects and work independently
- Expand and deepen their understanding through a process of lifelong learning

Program structure

The program is split into the core qualifications, the specialisation qualification and the Bachelor thesis.

The internship and the interdisciplinary final thesis is scheduled for the seventh semester.



Core qualification

Module M0577: Nontechnical Complementary Courses for Bachelors

| Module Responsible | Dagmar Richter |
|-----------------------------------|--|
| Admission Requirements | None |
| Recommended Previous Knowledge | None |
| Educational Objectives | After taking part successfully, students have reached the following learning results |
| Don't a sala sala | |

Professional Competence

The Non-technical Academic Programms (NTA)

imparts skills that, in view of the TUHH's training profile, professional engineering studies require but are not able to cover fully. Self-reliance, self-management, collaboration and professional and personnel management competences. The department implements these training objectives in its teaching architecture, in its teaching and learning arrangements, in teaching areas and by means of teaching offerings in which students can qualify by opting for specific competences and a competence level at the Bachelor's or Master's level. The teaching offerings are pooled in two different catalogues for nontechnical complementary courses.

The Learning Architecture

consists of a cross-disciplinarily study offering. The centrally designed teaching offering ensures that courses in the nontechnical academic programms follow the specific profiling of TUHH degree courses.

The learning architecture demands and trains independent educational planning as regards the individual development of competences. It also provides orientation knowledge in the form of "profiles"

The subjects that can be studied in parallel throughout the student's entire study program - if need be, it can be studied in one to two semesters. In view of the adaptation problems that individuals commonly face in their first semesters after making the transition from school to university and in order to encourage individually planned semesters abroad, there is no obligation to study these subjects in one or two specific semesters during the course of studies.

Teaching and Learning Arrangements

provide for students, separated into B.Sc. and M.Sc., to learn with and from each other across semesters. The challenge of dealing with interdisciplinarity and a variety of stages of learning in courses are part of the learning architecture and are deliberately encouraged in specific courses.

Fields of Teaching

Knowledge

are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studies, migration studies, communication studies and sustainability research, and from engineering didactics. In addition, from the winter semester 2014/15 students on all Bachelor's courses will have the opportunity to learn about business management and start-ups in a goal-oriented way.

The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging goal-oriented communication skills, e.g. the skills required by outgoing engineers in international and intercultural situations.

The Competence Level

of the courses offered in this area is different as regards the basic training objective in the Bachelor's and Master's fields. These differences are reflected in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theoretical level of abstraction in the B.Sc.

This is also reflected in the different quality of soft skills, which relate to the different team positions and different group leadership functions of Bachelor's and Master's graduates in their future working life.



Specialized Competence (Knowledge)

Students can

- locate selected specialized areas with the relevant non-technical mother discipline,
- outline basic theories, categories, terminology, models, concepts or artistic techniques in the disciplines represented in the learning area,
- · different specialist disciplines relate to their own discipline and differentiate it as well as make connections,
- sketch the basic outlines of how scientific disciplines, paradigms, models, instruments, methods and forms of representation in the specialized sciences are subject to individual and socio-cultural interpretation and historicity,
- Can communicate in a foreign language in a manner appropriate to the subject.

Professional Competence (Skills)

In selected sub-areas students can

Skills

- apply basic methods of the said scientific disciplines,
- auestion a specific technical phenomena, models, theories from the viewpoint of another, aforementioned specialist discipline,
- to handle simple questions in aforementioned scientific disciplines in a sucsessful manner,
- justify their decisions on forms of organization and application in practical questions in contexts that go beyond the technical relationship to the subject.

Personal Competence

Social Competence

Personal Competences (Social Skills)

Students will be able

- · to learn to collaborate in different manner,
 - to present and analyze problems in the abovementioned fields in a partner or group situation in a manner appropriate to the addressees,
 - to express themselves competently, in a culturally appropriate and gender-sensitive manner in the language of the country (as far as this study-focus would be chosen),
 - to explain nontechnical items to auditorium with technical background knowledge.

Personal Competences (Self-reliance)

Students are able in selected areas

Autonomy

- to reflect on their own profession and professionalism in the context of real-life fields of
- to organize themselves and their own learning processes
- to reflect and decide questions in front of a broad education background
- to communicate a nontechnical item in a competent way in writen form or verbaly
- to organize themselves as an entrepreneurial subject country (as far as this study-focus would be chosen)

Workload in Hours Depends on choice of courses

Credit points 6

Courses

Information regarding lectures and courses can be found in the corresponding module handbook published separately.



| Module M0743: Electrical Engineering I: Direct Current Networks and Electromagnetic | ı |
|---|---|
| Fields | |
| | ı |

| Courses | | | | |
|-----------------------------------|--|----------------------------|--------|----|
| Title | | Тур | Hrs/wk | CP |
| Electrical Engineering I: Dire | ct Current Networks and Electromagnetic Fields (L0675) | Lecture | 3 | 5 |
| Electrical Engineering I: Dire | ct Current Networks and Electromagnetic Fields (L0676) | Recitation Section (small) | 2 | 1 |
| Module Responsible | Prof. Manfred Kasper | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | | | | |
| | *6 | | | |

Knowledge Skills

Personal Competence
Social Competence

Autonomy

Workload in Hours Independent Study Time 110, Study Time in Lecture 70

Mechatronics: Core qualification: Compulsory

Credit points 6

| Or call points | <u> </u> | | | | |
|--------------------------------|-----------------|------------------|--------------------|-------------|--|
| Studienleistung | Compulson No | ry Bonus 10 % | Form Excercises | Description | |
| Examination | Written exa | m | | | |
| Examination duration and scale | zweistündiç | J | | | |
| | | | | | |

General Engineering Science (German program): Core qualification: Compulsory
General Engineering Science (German program, 7 semester): Core qualification: Compulsory
Electrical Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: Compulsory

| Course L0675: Electrical Engineering I: Direct Current Networks and Electromagnetic Fields | | | | |
|--|---|--|--|--|
| Тур | Lecture | | | |
| Hrs/wk | 3 | | | |
| СР | 5 | | | |
| Workload in Hours | Independent Study Time 108, Study Time in Lecture 42 | | | |
| Lecturer | Prof. Manfred Kasper | | | |
| Language | DE | | | |
| Cycle | WiSe | | | |
| Content | | | | |
| Literature | M. Kasper, Skript zur Vorlesung Elektrotechnik 1, 2013 M. Albach: Grundlagen der Elektrotechnik 1, Pearson Education, 2004 F. Moeller, H. Frohne, K.H. Löcherer, H. Müller: Grundlagen der Elektrotechnik, Teubner, 2005 A. R. Hambley: Electrical Engineering, Principles and Applications, Pearson Education, 2008 | | | |



| Course L0676: Electrical Engineering I: Direct Current Networks and Electromagnetic Fields | | | |
|--|--|--|--|
| Тур | Typ Recitation Section (small) | | |
| Hrs/wk | Hrs/wk 2 | | |
| СР | 1 | | |
| Workload in Hours | Workload in Hours Independent Study Time 2, Study Time in Lecture 28 | | |
| Lecturer | Prof. Manfred Kasper | | |
| Language | DE | | |
| Cycle | Cycle WiSe | | |
| Content | Content | | |
| Literature | Übungsaufgaben zur Elektrotechnik 1, TUHH, 2013 Ch. Kautz: Tutorien zur Elektrotechnik, Pearson Studium, 2010 | | |



| Module M0889: Me | echanics I (Stati | cs) | | | |
|-----------------------------------|--|-------------------------|-------------------------------------|---------------|----------------|
| 0.0000000 | | | | | |
| Courses | | | | Hara to de | |
| Title Mechanics I (Statics) (L100 | 1) | | Typ Lecture | Hrs/wk 2 | CP 3 |
| Mechanics I (Statics) (L100 | • | | Recitation Section (sma | | 2 |
| Mechanics I (Statics) (L100 | | | Recitation Section (large | , | 1 |
| Module Responsible | Prof. Robert Seifried | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | Solid school knowle | dge in mathematics a | nd physics. | | |
| Educational Objectives | After taking part succ | cessfully, students hav | e reached the following learni | ng results | |
| Professional Competence | | | | | |
| | The students can | | | | |
| Knowledge | describe the axiomatic procedure used in mechanical contexts; explain important steps in model design; present technical knowledge in stereostatics. | | | | |
| | The students can | The students can | | | |
| Skills | explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems; apply basic statical methods to engineering problems; estimate the reach and boundaries of statical methods and extend them to be applicable to wider problem sets. | | | | |
| Personal Competence | | | | | |
| Social Competence | The students are well in many and authority and other to all students and difficulties | | | | |
| Autonomy | Students are capable of determining their own strengths and weaknesses and to organize their time and learning based on those. | | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | | |
| Credit points | 6 | | | | |
| Studienleistung | Compulsory Bonus | Form Midterm | Description Wird nur im W | /iSe angebote | n |
| Examination | on Written exam | | | | |
| Examination duration and scale | 90 min | | | | |
| | General Engineering Civil- and Environme Mechanical Enginee Mechatronics: Core | g Science (German pr | sory | | pulsory |



| Course L1001: Mechanics I (Statics) | | | |
|-------------------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Robert Seifried | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Tasks in Mechanics Modelling and model elements Vector calculus for forces and torques Forces and equilibrium in space Constraints and reactions, characterization of constraint systems Planar and spatial truss structures Internal forces and moments for beams and frames Center of mass, volumn, area and line Computation of center of mass by intergals, joint bodies Friction (sliding and sticking) Friction of ropes | | |
| Literature | K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1.11. Auflage, Springer (2011). | | |

| Course L1002: Mechanics I (Statics) | | |
|-------------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Robert Seifried | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Forces and equilibrium Constraints and reactions Frames Center of mass Friction Internal forces and moments for beams | |
| Literature | K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1. 11. Auflage, Springer (2011). | |



| Course L1003: Mechanics I (Statics) | | |
|-------------------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Robert Seifried | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Forces and equilibrium Constraints and reactions Frames Center of mass Friction Internal forces and moments for beams | |
| Literature | K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1. 11. Auflage, Springer (2011). | |



| Analysis I (L1010) Analysis I (L1012) Analysis I (L1012) Analysis I (L1013) Analysis I (L | Module M0850: Mathematics I | | | |
|--|---|----------------|--|--|
| Title Analysis I (L1010) Analysis I (L1012) Analysis I (L1012) Analysis I (L1013) Analysis I (L10913) Analysis I (L10914) Analysis I (L10913) Analysis I (L10913) Analysis I (L10914) Analysis I (L10913) Analysis I (L10914) Analysis I (L10913) Analysis I (L10914) Analysis I (L10913) Analysis | | | | |
| Analysis I (L1012) Analysis I (L1013) Analysis I (L1014) Analysis I (L | Hrs/wk | CP | | |
| Linear Algebra I (L0912) Linear Algebra I (L0913) Linear Algebra I (L0914) Recitation Section (small) Recitation Section (small) Recitation Section (small) Recitation Section (small) Recitation Section (large) Module Responsible Admission Requirements Recommended Previous Knowledge Educational Objectives After taking part successfully, students have reached the following learning res Professional Competence Students can name the basic concepts in analysis and linear algebra. them using appropriate examples. Students can discuss logical connections with the help of examples. They know proof strategies and can reproduce them. Students can model problems in analysis and linear algebra with the studied in this course. Moreover, they are capable of solving them I methods. Studies are able to discover and verify further logical connections studied in the course. For a given problem, the students can develop and execute a suitable to critically evaluate the results. Personal Competence Social Competence Social Competence Social Competence Students are able to work together in teams. They are capable to common language. In doing so, they can communicate new concepts according to the ne partners. Moreover, they can design examples to check and deepen th peers. Students are capable of checking their understanding of complex concan specify open questions precisely and know where to get help in so Students have developed sufficient persistence to be able to work for I oriented manner on hard problems. | | 1 | | |
| Linear Algebra (L0914) Recitation Section (small) 1 Recitation Section (large) 1 | 1 | 1 | | |
| Module Responsible Prof. Anusch Taraz | 2 | 2 | | |
| Module Responsible Admission Requirements None School mathematics | 1 | 1 | | |
| Requirements Recommended Previous Knowledge Educational Objectives After taking part successfully, students have reached the following learning res | 1 | 1 | | |
| Requirements Recommended Previous Knowledge School mathematics | | | | |
| Previous Knowledge Educational Objectives After taking part successfully, students have reached the following learning res | | | | |
| Professional Competence Students can name the basic concepts in analysis and linear algebra. them using appropriate examples. Students can discuss logical connections between these concepts. illustrating these connections with the help of examples. They know proof strategies and can reproduce them. Students can model problems in analysis and linear algebra with the studied in this course. Moreover, they are capable of solving them the studied in the course. Students are able to discover and verify further logical connections studied in the course. For a given problem, the students can develop and execute a suitable to critically evaluate the results. Personal Competence Students are able to work together in teams. They are capable to common language. In doing so, they can communicate new concepts according to the ne partners. Moreover, they can design examples to check and deepen the peers. Students are capable of checking their understanding of complex concan specify open questions precisely and know where to get help in so Students have developed sufficient persistence to be able to work for loriented manner on hard problems. Workload in Hours Independent Study Time 128, Study Time in Lecture 112 Credit points None | | | | |
| Students can name the basic concepts in analysis and linear algebra. them using appropriate examples. Students can discuss logical connections between these concepts. illustrating these connections with the help of examples. They know proof strategies and can reproduce them. Students can model problems in analysis and linear algebra with the studied in this course. Moreover, they are capable of solving them the methods. Students are able to discover and verify further logical connections studied in the course. For a given problem, the students can develop and execute a suitable to critically evaluate the results. Personal Competence Social Competence Social Competence Students are able to work together in teams. They are capable to common language. In doing so, they can communicate new concepts according to the ne partners. Moreover, they can design examples to check and deepen the peers. Students are capable of checking their understanding of complex concepts according to the nepartners. Moreover, they can design examples to check and deepen the peers. Students are capable of checking their understanding of complex concepts according to the nepartners. Moreover, they can design examples to check and deepen the peers. Students are capable of checking their understanding of complex concepts according to the nepartners. Moreover, they can design examples to check and deepen the peers. Students are capable of checking their understanding of complex concepts according to the nepartners. Students are capable of checking their understanding of complex concepts according to the nepartners. Students are capable of checking their understanding of complex concepts according to the nepartners. | results | | | |
| them using appropriate examples. Students can discuss logical connections between these concepts. illustrating these connections with the help of examples. They know proof strategies and can reproduce them. Students can model problems in analysis and linear algebra with the studied in this course. Moreover, they are capable of solving them to methods. Students are able to discover and verify further logical connections studied in the course. For a given problem, the students can develop and execute a suitable to critically evaluate the results. Personal Competence Social Competence Social Competence Students are able to work together in teams. They are capable to common language. In doing so, they can communicate new concepts according to the ne partners. Moreover, they can design examples to check and deepen the peers. Students are capable of checking their understanding of complex concean specify open questions precisely and know where to get help in so students have developed sufficient persistence to be able to work for loriented manner on hard problems. Workload in Hours Independent Study Time 128, Study Time in Lecture 112 Credit points Studienleistung None | | | | |
| studied in this course. Moreover, they are capable of solving them to methods. Students are able to discover and verify further logical connections studied in the course. For a given problem, the students can develop and execute a suitable to critically evaluate the results. Personal Competence Students are able to work together in teams. They are capable to common language. In doing so, they can communicate new concepts according to the ne partners. Moreover, they can design examples to check and deepen the peers. Students are capable of checking their understanding of complex concepts according to the nepartners. Moreover, they can design examples to check and deepen the peers. Students are capable of checking their understanding of complex concepts according to the nepartners. Moreover, they can design examples to check and deepen the peers. Students are capable of checking their understanding of complex concepts according to the nepartners. Moreover, they can design examples to check and deepen the peers. Students are capable of checking their understanding of complex concepts according to the nepartners. Moreover, they can design examples to check and deepen the peers. | Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. | | | |
| Students are able to work together in teams. They are capable to common language. In doing so, they can communicate new concepts according to the ne partners. Moreover, they can design examples to check and deepen the peers. Students are capable of checking their understanding of complex concan specify open questions precisely and know where to get help in solenge to the students have developed sufficient persistence to be able to work for looking the students have developed sufficient persistence to be able to work for looking the students have developed sufficient persistence to be able to work for looking the students have developed sufficient persistence to be able to work for looking the students have developed sufficient persistence to be able to work for looking the students have developed sufficient persistence to be able to work for looking the students have developed sufficient persistence to be able to work for looking the students have developed sufficient persistence to be able to work for looking the students have developed sufficient persistence to be able to work for looking the students have developed sufficient persistence to be able to work for looking the students have developed sufficient persistence to be able to work for looking the students have developed sufficient persistence to be able to work for looking the students have developed sufficient persistence to be able to work for looking the students have developed sufficient persistence to be able to work for looking the students have developed sufficient persistence to be able to work for looking the students have developed sufficient persistence to be able to work for looking the students have developed sufficient persistence to be able to work for looking the students have developed sufficient persistence to be able to work for looking the students have developed sufficient persistence to be able to work for looking the students have developed sufficient persistence to be able to work for looking the students have developed suffi | Students are able to discover and verify further logical connections between the concepts studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able | | | |
| common language. In doing so, they can communicate new concepts according to the ne partners. Moreover, they can design examples to check and deepen the peers. Students are capable of checking their understanding of complex concean specify open questions precisely and know where to get help in soles oriented manner on hard problems. Workload in Hours Independent Study Time 128, Study Time in Lecture 112 Credit points Studienleistung None | | | | |
| can specify open questions precisely and know where to get help in solonomy Students have developed sufficient persistence to be able to work for looriented manner on hard problems. Workload in Hours Independent Study Time 128, Study Time in Lecture 112 Credit points Studienleistung None | needs of the | eir cooperatin | | |
| Credit points 8 Studienleistung None | solving them | m. | | |
| Credit points 8 Studienleistung None | | | | |
| Studienleistung None | | | | |
| | | | | |
| Francisco Military and a | | | | |
| Examination Written exam | | | | |
| Examination duration | | | | |



| and scale | 60 min (Analysis I) + 60 min (Linear Algebra I) |
|---|---|
| Assignment for the Following Curricula | Computational Science and Engineering: Core qualification: Compulsory |

| Course L1010: Analysis I | | |
|--------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Foundations of differential and integrational calculus of one variable • statements, sets and functions • natural and real numbers • convergence of sequences and series • continuous and differentiable functions • mean value theorems • Taylor series • calculus • error analysis • fixpoint iteration | |
| Literature | http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html | |

| Course L1012: Analysis I | | |
|--------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Course L1013: Analysis I | | |
|--------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L0912: Linear Algebra I | | |
|--------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Anusch Taraz, Prof. Marko Lindner | |
| Language | DE | |
| Cycle | WiSe | |
| Content | vectors: intuition, rules, inner and cross product, lines and planes systems of linear equations: Gauß elimination, matrix product, inverse matrices, transformations, block matrices, determinants orthogonal projection in R^n, Gram-Schmidt-Orthonormalization | |
| Literature | T. Arens u.a.: Mathematik, Spektrum Akademischer Verlag, Heidelberg 2009 W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 G. Strang: Lineare Algebra, Springer-Verlag, 2003 G. und S. Teschl: Mathematik für Informatiker, Band 1, Springer-Verlag, 2013 | |

| Course L0913: Linear Algebra I | | |
|--------------------------------|--|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Anusch Taraz, Prof. Marko Lindner | |
| Language | DE | |
| Cycle | WiSe | |
| Content | vectors: intuition, rules, inner and cross product, lines and planes general vector spaces: subspaces, Euclidean vector spaces systems of linear equations: Gauß-elimination, matrix product, inverse matrices, transformations, LR-decomposition, block matrices, determinants | |
| Literature | T. Arens u.a.: Mathematik, Spektrum Akademischer Verlag, Heidelberg 2009 W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 | |



| Course L0914: Linear Algebra I | |
|--------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Christian Seifert |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M1315: Ph | nysics for Engineers (AIW) | | | |
|--|---|--|-------------------------|---------------------|
| Courses | | | | |
| Title Physics for Engineers (L0367) Physics for Engineers (Problem Solving Course) (L0368) | | Typ Lecture Recitation Section (small) | Hrs/wk 2 1 | CP 3 1 |
| Module Responsible | Prof. Manfred Eich | | | |
| Admission Requirements | INONE | | | |
| Recommended Previous Knowledge | 3 3 | ol level | | |
| Educational Objectives | After taking part successfully, students have reach | hed the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Students can explain fundamental topics and laws of physics such as in the areas of mechanics oscillations, waves, and optics. | | | of mechanics, |
| Skills | Students can relate physics topics to technical problems. Students can describe physical problems mathematically and solve such problems within the framework of their acquired mathematical expertise. | | | |
| Personal Competence | | | | |
| Social Competence | Students can jointly solve subject related problen within the framework of the problem solving cours | | sent their re | sults effectively |
| Autonomy | Students are capable to extract relevant information from the provided references and to relate this information to the content of the lecture. They can reflect their acquired level of expertise with the help of lecture accompanying measures such as exam typical exam questions. Students are able to connect their knowledge with that acquired from other lectures. | | | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | | | |
| Credit points | 4 | | | |
| Studienleistung | None | | | |
| | Written exam | | | |
| Examination duration and scale | 1120 min | | | |
| Assignment for the Following Curricula | | 7 semester): Core qualific | ation: Comp | ulsory |



| Course L0367: Physics for Engineers | | | |
|-------------------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Manfred Eich | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Introduction Kinematics and dynamics Work, Energy, momentum Rotatory Motion, moments of inertia Gravitation Special Theory of Relativity Oscillations Waves Geometrical optics Wave optics Matter waves Fundamentals of quantum mechanics | | |
| Literature | Giancoli, Physics for Scientists & Engineers Vol. 1, 2, Pearson Halliday/Resnik/Walker, Fundamentals of physics, Wiley K. Cummings, P. Laws, E. Redish, and P. Cooney ("CLRC"), Understanding Physics, Wiley Gerthsen/Vogel, Physik, Springer Verlag Hering/Martin/Stohrer, Physik für Ingenieure, VDI-Verlag | | |

| Course L0368: Physics for Engineers (Problem Solving Course) | | |
|--|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Manfred Eich | |
| Language | DE | |
| Cycle | WiSe | |
| Content | see lecture Physics for Engineers | |
| Literature | see lecture Physics for Engineers | |



| Module M0687: Ch | emistry | | | |
|-----------------------------------|--|---|-------------|--------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Chemistry I (L0460) | | Lecture | 2 | 2 |
| Chemistry I (L0475) | | Recitation Section (large) | 1 | 1 |
| Chemistry II (L0465) | | Lecture | 2 | 2 |
| Chemistry II (L0476) | | Recitation Section (large) | 1 | 1 |
| Module Responsible | Dr. Dorothea Rechtenbach | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | none | | | |
| Educational Objectives | After taking part successfully, students have reach | ed the following learning | results | |
| Professional | | | | |
| Competence | The state of the s | | | |
| Knowledge | The students are able to name and to describe basic principles and applications of general chemistry (structure of matter, periodic table, chemical bonds), physical chemistry (aggregate states, separating processes, thermodynamics, kinetics), inorganic chemistry (acid/base, pH-value, salts, solubility, redox, metals) and organic chemistry (aliphatic hydrocarbons, functional groups, carbonyl compounds, aromates, reaction mechanisms, natural products, synthetic polymers). Furthermore students are able to explain basic chemical terms. | | | |
| Skills | After successful completion of this module students are able to describe substance groups and chemical compounds. On this basis, they are capable of explaining, choosing and applying specific methods and various reaction mechanisms. | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to take part in discussions on chemical issues and problems as a member of an interdisciplinary team. They can contribute to those discussion by their own statements. | | | member of an |
| Autonomy | After successful completion of this module students are able to solve chemical problems independently by defending proposed approaches with arguments. They can also document their approaches. | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture | e 84 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 120 min | | | |
| | General Engineering Science (German program): General Engineering Science (German program, 7 Civil- and Environmental Engineering: Core qualif Technomathematics: Specialisation III. Engineerin | 7 semester): Core qualific fication: Compulsory | ation: Comp | ulsory |



| Course L0460: Chemistry I | | |
|---------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Dr. Christoph Wutz | |
| Language | | |
| Cycle | WiSe | |
| Content | - Structure of matter - Periodic table - Electronegativity - Chemical bonds - Solid compounds and solutions - Chemistry of water - Chemical reactions and equilibria - Acid-base reactions - Redox reactions | |
| Literature | - Blumenthal, Linke, Vieth: Chemie - Grundwissen für Ingenieure - Kickelbick: Chemie für Ingenieure (Pearson) - Mortimer: Chemie. Basiswissen der Chemie Brown, LeMay, Bursten: Chemie. Studieren kompakt. | |

| Course L0475: Chemistry I | | |
|---------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dr. Dorothea Rechtenbach | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Course L0465: Chemisti | у ІІ |
|------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Christoph Wutz |
| Language | DE |
| Cycle | WiSe |
| Content | Simple compounds of carbon, aliphatic hydrocarbons, aromatic hydrocarbons, Alkohols, phenols, ether, aldehydes, ketones, carbonic acids, ester, amines, amino acids, fats, sugars Reaction mechanisms, radical reactions, nucleophilic substitution, elimination reactions, addition reaction Practical apllications and examples |
| Literature | Blumenthal, Linke, Vieth: Chemie - Grundwissen für Ingenieure Kickelbick: Chemie für Ingenieure (Pearson) Schmuck: Basisbuch Organische Chemie (Pearson) |

| Course L0476: Chemist | ourse L0476: Chemistry II | | |
|-----------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Dr. Dorothea Rechtenbach | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |



| Module M1121: Pro | ogramming in C | | | | |
|---|--|---|---------------------|------------|--|
| Courses | | | | | |
| Title | | Тур | Hrs/wk | СР | |
| Programming in C (L0083) Programming in C (L1488) | | Lecture Practical Course | 1 1 | 1 1 | |
| Module Responsible | Prof. Siegfried Rump | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | Elementary PC handling skills Elementary mathematical skills | | | | |
| | · | | | | |
| - | After taking part successfully, students have | reached the following learn | ning results | | |
| Professional Competence | | | | | |
| | The students know by heart the basic syntax purpose. | of C programming as well | as its meaning, | intent and | |
| | They know the fundamental components an based on C programming and can explain t | | procedural prog | ramming | |
| Knowledge | basic data types (integers, floating point nutral advanced data types (pointers, arrays, strint operators (arithmetical operations, logical of control flow (choice, loops, jumps, conditione functions and macrose of important standard libraries and functionse or recursione of the standard libraries and functionse of the standard libraries are standard libraries and functionse of the standard libraries and standard librari | ngs, composed data types, operations, bit operations) | type conversion |) | |
| | The students are prepared for continuing programming lectures like object oriented programming in C++. | | | | |
| | The students know how to use an integrated development environment for C programming on a PC so that they can write, store, compile and execute C programs on it. | | | | |
| | Using their knowledge they are able to read and understand given C Programs. | | | | |
| Skills | They can solve simple algorithmic problems on their own and can model and program their solutions in C language. | | | | |
| | The students are able to solve selected exercises from other areas of their study like mathematics, mechanics, electrical engineering or physics with the aid of small C programs/-projects numerically. | | | | |
| Personal Competence | | | | | |
| Social Competence | The students are able to work in small teams programming errors and to present their res | | ks, to identify and | d analyze | |
| Social Competence | They are able to explain simple phenomena to each other directly at the PC. | | | | |
| | The students prepare themselves using the given teaching material and solve the given programming exercises on their own. | | | | |
| _ | Additionally, they write small C programs to understand and check addressed issues and also to gain a certain programming experience. | | | | |
| | For details beyond the scope of the lecture t literature and / or by supplementary own res | | ves using the sta | ated | |
| Workload in Hours | Independent Study Time 32, Study Time in L | ecture 28 | | | |
| Credit points | 2 | | | | |
| Studienleistung | None | | | | |



| Examination | Written elaboration | |
|----------------------|---|--|
| Examination duration | 1-2 coding tasks weekly | |
| and scale | 2 coding tasks weekly | |
| | General Engineering Science (German program): Core qualification: Compulsory | |
| Assignment for the | General Engineering Science (German program, 7 semester): Core qualification: Compulsory | |
| Following Curricula | General Engineering Science (English program): Core qualification: Compulsory | |
| | General Engineering Science (English program, 7 semester): Core qualification: Compulsory | |

| ourse L0083: Programming in C | | |
|-------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Siegfried Rump, Weitere Mitarbeiter | |
| Language | DE/EN | |
| Cycle | WiSe | |
| Content | C-Programming: basic data types (integers, floating point numbers, characters, boolean values) advanced data types (pointers, arrays, strings, composed data types, type conversion) operators (arithmetical operations, logical operations, bit operations) control flow (choice, loops, jumps, conditional compilation) functions and macros (basic function definitions and calls, program parameters, "call by value" versus "call by reference", storage classes, functions with variable many arguments, macros, inline functions, modular design, function pointers) important standard libraries and functions (stdio.h, stdlib.h, math.h, string.h, ctype.h, time.h) example programs for technical and mathematical applications | |
| Literature | Kernighan, Brian W (Ritchie, Dennis M.;) The C programming language ISBN: 9780131103702 Upper Saddle River, NJ [u.a.]: Prentice Hall PTR, 2009 Sedgewick, Robert Algorithms in C ISBN: 0201316633 Reading, Mass. [u.a.]: Addison-Wesley, 2007 Kaiser, Ulrich (Kecher, Christoph.;) C/C++: Von den Grundlagen zur professionellen Programmierung ISBN: 9783898428392 Bonn: Galileo Press, 2010 Wolf, Jürgen C von A bis Z: das umfassende Handbuch ISBN: 3836214113 Bonn: Galileo Press, 2009 | |

| Course L1488: Programming in C | | |
|--------------------------------|---|--|
| Тур | Practical Course | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Siegfried Rump, Weitere Mitarbeiter | |
| Language | DE/EN | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0547: Ele | ectrical Engineerin | g II: Alternating C | urrent Networks an | ıd Basic | Devices |
|---|--|--|---|--|--|
| Courses | | | | | |
| • • | Title Electrical Engineering II: Alternating Current Networks and Basic Devices (L0178) Electrical Engineering II: Alternating Current Networks and Basic Devices (L0179) | | Typ Lecture Recitation Section (small) | Hrs/wk 3 2 | CP 5 1 |
| Module Responsible | Prof. Christian Becker | | | | |
| Admission Requirements | INIONO | | | | |
| Recommended Previous Knowledge | Electrical Engineering I Mathematics I Direct current networks, c | complex numbers | | | |
| Educational Objectives | After taking part successf | ully, students have reach | ned the following learning | results | |
| Professional Competence Knowledge | Students are able to repr the theory of alternating notation for voltages and alternating currents in the | currents. They can des I currents. They can rep ne area of electrical en | amental theories, principled in the cribe networks of linear of a produce an overview of application. Students are senses as well as their impact | elements us oplications f capable of | sing a complex or the theory of explaining the |
| Skills | Students are capable of calculating parameters within simple electrical networks at alternating currents by means of a complex notation for voltages and currents. They can appraise the fundamenta effects that may occur within electrical networks at alternating currents. Students are able to analyze simple circuits such as oscillating circuits, filter, and matching networks quantitatively and dimension elements by means of a design. They can motivate and justify the fundamental elements of ar electrical power supply (transformer, transmission line, compensation of reactive power, multiphase system) and are qualified to dimension their main features. | | | | |
| Personal Competence | | | | | |
| Social Competence | Students are able to work their results effectively. | k together on subject rel | ated tasks in small group: | s. They are | able to present |
| Autonomy | Students are capable to gather necessary information from the references provided and relate that information to the context of the lecture. They are able to continually reflect their knowledge by means of activities that accompany the lecture, such as online-tests and exercises that are related to the exam. Based on respective feedback, students are expected to adjust their individual learning process. They are able to draw connections between their knowledge obtained in this lecture and the content of other lectures (e.g. Electrical Engineering I, Linear Algebra, and Analysis). | | | | |
| Workload in Hours | Independent Study Time | 110, Study Time in Lectu | ire 70 | | |
| Credit points | | · | | | |
| Studienleistung | Compulsory Bonus No 10 % | Form Midterm | Description | | |
| Examination | Written exam | | | | |
| Examination duration and scale | 190 - 150 minutes | | | | |



General Engineering Science (German program): Core qualification: Compulsory

Assignment for the General Engineering Science (German program, 7 semester): Core qualification: Compulsory

Following Curricula Electrical Engineering: Core qualification: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

| Course L0178: Electrical Engineering II: Alternating Current Networks and Basic Devices | | | |
|---|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 3 | | |
| СР | 5 | | |
| Workload in Hours | ndependent Study Time 108, Study Time in Lecture 42 | | |
| Lecturer | Prof. Christian Becker | | |
| Language | | | |
| Cycle | | | |
| | - General time-dependency of electrical networks | | |
| | - Representation and properties of harmonic signals | | |
| | - RLC-elements at alternating currents/voltages | | |
| | - Complex notation for the representation of RLC-elements | | |
| | - Power in electrical networks at alternating currents, compensation of reactive power | | |
| Content | - Frequency response locus (Nyquist plot) and Bode-diagrams | | |
| | - Measurement instrumentation for assessing alternating currents | | |
| | - Oscillating circuits, filters, electrical transmission lines | | |
| | - Transformers, three-phase current, energy converters | | |
| | - Simple non-linear and active electrical devices | | |
| | | | |
| | - M. Albach, "Elektrotechnik", Pearson Studium (2011) | | |
| | - T. Harriehausen, D. Schwarzenau, "Moeller Grundlagen der Elektrotechnik", Springer (2013) | | |
| | - R. Kories, H. Schmidt-Walter, "Taschenbuch der Elektrotechnik", Harri Deutsch (2010) | | |
| Literature | - C. Kautz, "Tutorien zur Elektrotechnik", Pearson (2009) | | |
| | - A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2013) | | |
| | - R. Dorf, "The Electrical Engineering Handbook", CRC (2006) | | |
| | | | |
| | | | |



| Course L0179: Electrica | ourse L0179: Electrical Engineering II: Alternating Current Networks and Basic Devices | | | |
|-------------------------|---|--|--|--|
| Тур | Recitation Section (small) | | | |
| Hrs/wk | 2 | | | |
| СР | 1 | | | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | | | |
| Lecturer | Prof. Christian Becker | | | |
| Language | DE | | | |
| Cycle | SoSe | | | |
| | - General time-dependency of electrical networks | | | |
| | - Representation and properties of harmonic signals | | | |
| | - RLC-elements at alternating currents/voltages | | | |
| | - Complex notation for the representation of RLC-elements | | | |
| | - Power in electrical networks at alternating currents, compensation of reactive power | | | |
| Content | - Frequency response locus (Nyquist plot) and Bode-diagrams | | | |
| | - Measurement instrumentation for assessing alternating currents | | | |
| | - Oscillating circuits, filters, electrical transmission lines | | | |
| | - Transformers, three-phase current, energy converters | | | |
| | - Simple non-linear and active electrical devices | | | |
| | | | | |
| | - M. Albach, "Elektrotechnik", Pearson Studium (2011) | | | |
| | - T. Harriehausen, D. Schwarzenau, "Moeller Grundlagen der Elektrotechnik", Springer (2013) | | | |
| | - R. Kories, H. Schmidt-Walter, "Taschenbuch der Elektrotechnik", Harri Deutsch (2010) | | | |
| Literature | - C. Kautz, "Tutorien zur Elektrotechnik", Pearson (2009) | | | |
| | - A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2013) | | | |
| | - R. Dorf, "The Electrical Engineering Handbook", CRC (2006) | | | |
| | | | | |
| | | | | |



| Module M0594: Fu | ındar | mentals o | f Mechanica | l Engineer | ing Design | | | |
|---|---|--|---|---|---|-----------------------|------------------|---------------------|
| Courses | | | | | | | | |
| Title Fundamentals of Mechanica Fundamentals of Mechanica | - | | ` ' | | Typ Lecture Recitation Section (lar | ge) | Hrs/wk 2 2 | CP 3 3 |
| Module Responsible | Prof. I | Dieter Krause |) | | | | | |
| Admission Requirements | None | | | | | | | |
| Recommended Previous Knowledge | | | rledge about med Stage I Practical) | - | oduction engineering | 9 | | |
| Educational Objectives | After t | aking part su | ccessfully, stude | nts have reach | ed the following lear | ning r | esults | |
| Professional Competence | | | | | | | | |
| Knowledge | | explain bas | uirements, selec | ples and functi tion criteria, ap | ons of machine elem oplication scenarios d of dimensioning ca | and p | | amples of basi |
| Skills | | accomplish transfer kno skills), recognize t | owledge learned | alculations of c I in the modul hnical drawing | overed machine eler e to new requireme s and schematic ske | nts a | nd tasks (p | oroblem solvinç |
| Personal Competence Social Competence | | Students a methods. | re able to discu | uss technical | information in the I | ecture | e supporte | d by activating |
| Autonomy | Students are able to independently deepen their acquired knowledge in exercises. Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures. | | | | | | | |
| Workload in Hours | Indep | endent Study | Time 124, Study | / Time in Lectu | re 56 | | | |
| Credit points | 6 | | | | | | | |
| Studienleistung | 1 | | | | | | | |
| Examination | ļ | n exam | | | | | | |
| Examination duration and scale | 1120 | | | | | | | |
| Assignment for the Following Curricula | Gene Energ Gene Logis Mech Mech Naval Techr | ral Engineering and Environal Engineering and Mobil anical Engineatronics: Corel Architecture nomathematical | ng Science (Gerr nmental Enginee ng Science (Engi ility: Core qualific eering: Core qual e qualification: Core : Core qualification | man program, pering: Core qualish program): cation: Compulsification: Compulsory on: Compulsory all. Engineerin | oulsory y g Science: Elective (| alifica ry ompu | ation: Comp | oulsory |



| Course L0258: Fundame | entals of Mechanical Engineering Design |
|-----------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause, Prof. Josef Schlattmann, Prof. Otto von Estorff, Prof. Sören Ehlers |
| Language | DE |
| Cycle | SoSe |
| Content | Introduction to design Introduction to the following machine elements |
| Literature | Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen |

| Course L0259: Fundamentals of Mechanical Engineering Design | | |
|---|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Dieter Krause, Prof. Josef Schlattmann, Prof. Otto von Estorff, Prof. Sören Ehlers | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

Following Curricula Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory



| Module M0696: Me | echanics II: Mechanics of Materials | | | | |
|-----------------------------------|---|-----------|---------|---------|--|
| | | | | | |
| Courses | | | | | |
| Title | Тур | | Hrs/wk | СР | |
| Mechanics II (L0493) | Lecture | | 2 | 2 | |
| Mechanics II (L0494) | Recitation Section (| small) | 2 | 2 | |
| Mechanics II (L1691) | Recitation Section (| large) | 2 | 2 | |
| Module Responsible | Prof. Christian Cyron | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | Mechanics I | | | | |
| Educational Objectives | After taking part successfully, students have reached the following le | arning ı | results | | |
| Professional | | | | | |
| Competence | | | | | |
| Knowledge | The students name the fundamental concepts and laws of statics such as stresses, strains, Hooke's linear law. | | | | |
| | The students apply the mathematical/mechanical analysis and mode | eling. | | | |
| | The students apply the fundamental mathed of close statics to simply | المممالية | | مسماط | |
| Ol:II- | The students apply the fundamental methods of elasto statics to simply engineering problems. | | | | |
| SKIIIS | Skills The students estimate the validity and limitations of the introduced methods. | | | | |
| | | | | | |
| | | | | | |
| Personal Competence | | | | | |
| Social Competence | - | | | | |
| Autonomy | - | | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 | | | | |
| Credit points | 6 | | | | |
| Studienleistung | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and scale | 90 min | | | | |
| | General Engineering Science (German program): Core qualification | : Compi | ulsory | | |
| | General Engineering Science (German program, 7 semester): Core | qualifica | | oulsory | |
| Assignment for the | Civil- and Environmental Engineering: Core qualification: Compulso | ry | | | |



| Course L0493: Mechanics II | | |
|----------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Christian Cyron | |
| Language | DE | |
| Cycle | SoSe | |
| Content | stresses and strains Hooke's law tension and compression torsion bending stability buckling energy methods | |
| Literature | Gross, D., Hauger, W., Schröder, J., Wall, W.A.: Technische Mechanik 1, Springer Gross, D., Hauger, W., Schröder, J., Wall, W.A.: Technische Mechanik 2 Elastostatik, Springer | |

| Course L0494: Mechanics II | | |
|----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Christian Cyron | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L1691: Mechanics II | | |
|----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Christian Cyron | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0671: Te | chnical Thermodynamics I | | | |
|--|--|---|------------------|---------------|
| Courses | | | | |
| Title Technical Thermodynamics Technical Thermodynamics Technical Thermodynamics | I (L0439) | Typ Lecture Recitation Section (large) Recitation Section (small) | Hrs/wk 2 1 | CP 4 1 |
| Module Responsible | Prof. Gerhard Schmitz | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Elementary knowledge in Mathematics and Mecha | anics | | |
| Educational Objectives | After taking part successfully, students have reach | ed the following learning | results | |
| Professional Competence | | | | |
| Knowledge Skills Personal Competence | Students are familiar with the laws of Thermodynamics. They know the relation of the kinds of energy according to 1 st law of Thermodynamics and are aware about the limits of energy conversions according to 2 nd law of Thermodynamics. They are able to distinguish between state variables and process variables and know the meaning of different state variables like temperature, enthalpy, entropy and also the meaning of exergy and anergy. They are able to draw the Carnot cycle in a Thermodynamics related diagram. They know the physical difference between an ideal and a real gas and are able to use the related equations of state. They know the meaning of a fundamental state of equation and know the basics of two phase Thermodynamics. Students are able to calculate the internal energy, the enthalpy, the kinetic and the potential energy as well as work and heat for simple change of states and to use this calculations for the Carnot cycle. They are able to calculate state variables for an ideal and for a real gas from measured thermal state variables. | | | |
| Social Competence | The students are able to discuss in small groups a Students are able to define independently tasks, | | rom existing | knowledge as |
| | well as to find ways to use the knowledge in practi | | | |
| | Independent Study Time 124, Study Time in Lectu | re 56 | | |
| Credit points | | | | |
| Studienleistung | Written exam | | | |
| Examination duration and scale | | | | |
| | General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Core qualification: Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Process Engineering: Core qualification: Compulsory | | ulsory | |



| ourse L0437: Technica | l Thermodynamics I |
|-----------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. Gerhard Schmitz |
| Language | DE |
| Cycle | SoSe |
| Content | Introduction Fundamental terms Thermal Equilibrium and temperature 3.1 Thermal equation of state First law 4.1 Heat and work 4.2 First law for closed systems 4.3 First law for open systems 4.4 Examples Equations of state and changes of state 5.1 Changes of state |
| Literature | Schmitz, G.: Technische Thermodynamik, TuTech Verlag, Hamburg, 2009 Baehr, H.D.; Kabelac, S.: Thermodynamik, 15. Auflage, Springer Verlag, Berlin 2012 Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993 |
| | |

| Course L0439: Technical Thermodynamics I | | |
|--|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Gerhard Schmitz | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Course L0441: Technical Thermodynamics I | | |
|--|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Gerhard Schmitz | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Analysis II (L1027) Linear Algebra II (L0915) Linear Algebra II (L0916) Linear Algebra II (L0917) Module Responsible Admission Requirements Recommended Previous Knowledge Educational Objectives Professional Competence Students can name further concepts in analysis them using appropriate examples. Students can discuss logical connections be illustrating these connections with the help of examples. Skills Skills Skills Personal Competence Social Competence Students can model problems in analysis and studied in this course. Moreover, they are can methods. Students are able to discover and verify further studied in the course. For a given problem, the students can develop to critically evaluate the results. Students are able to work together in teams common language. In doing so, they can communicate new concepartners. Moreover, they can design examples peers. Students are capable of checking their underst can specify open questions precisely and know. Students are capable of checking their underst can specify open questions precisely and know. | tation Section (large) tation Section (small) ure tation Section (small) tation Section (large) | Hrs/wk 2 1 1 2 1 | CP 2 1 1 2 1 |
|--|--|---|---|
| Analysis II (L1025) Analysis II (L1026) Analysis II (L1027) Analysis II (L1027) Analysis II (L1027) Analysis II (L0915) Linear Algebra II (L0915) Linear Algebra II (L0917) Module Responsible Admission Requirements Recommended Previous Knowledge Educational Objectives After taking part successfully, students have reached the musing appropriate examples. Students can name further concepts in analysis them using appropriate examples. Students can discuss logical connections be illustrating these connections with the help of examples. Students can model problems in analysis and studied in this course. Moreover, they are can methods. Stills Skills Personal Competence Social Competence Students are able to discover and verify further studied in the course. For a given problem, the students can develop to critically evaluate the results. Personal Competence Students are able to work together in teams common language. In doing so, they can communicate new conce partners. Moreover, they can design examples peers. Students are capable of checking their understance and sequeloned exifficient precisely and known as Students are developed examples precisely and known as Students are capable of checking their understance and sequeloned exifficient precisely and known as Students are capable of checking their understance and sequeloned exifficient precisely and known as Students are capable of checking their understance and sequeloned exifficient precisely and known as Students are capable of checking their understance and sequeloned exifficient precisely and known as Students have developed exifficient precisely and known as Students are developed exifficient precisely and known as Students have developed exifficient precisely and known as Students have developed exifficient precise and sequence as sufficient precise and sequence as suffic | tation Section (large) tation Section (small) ure tation Section (small) tation Section (large) | 2 1 1 2 1 | 2 1 1 2 1 |
| Analysis II (L1026) Analysis II (L1027) Linear Algebra II (L0915) Linear Algebra II (L0916) Linear Algebra II (L0917) Module Responsible Admission Requirements Recommended Previous Knowledge Educational Objectives Frofessional Competence **Students can name further concepts in analysis them using appropriate examples. **Students can discuss logical connections be illustrating these connections with the help of every they are can methods. **Students can model problems in analysis and studied in this course. Moreover, they are can methods. **Students can model problems in analysis and studied in the course. **Students can model problems in analysis and studied in the course. **Students are able to discover and verify further studied in the course. **For a given problem, the students can develop to critically evaluate the results. **Personal Competence** **Students are able to work together in teams common language. **In doing so, they can communicate new conce partners. Moreover, they can design examples peers. **Students are capable of checking their underst can specify open questions precisely and know on a Students have developed cufficient persistence. **Students are capable of checking their underst can specify open questions precisely and know on a Students have developed cufficient persistence. | tation Section (large) tation Section (small) ure tation Section (small) tation Section (large) | 1 1 2 1 | 1 1 2 1 |
| Analysis II (L1027) Reci Linear Algebra II (L0915) Lect Linear Algebra II (L0917) Reci Module Responsible Admission Requirements Recommended Previous Knowledge Educational Objectives After taking part successfully, students have reached the Professional Competence **Students can name further concepts in analysis them using appropriate examples.** **Students can discuss logical connections be illustrating these connections with the help of examples and the students can develop to critically evaluate the results. **Skills** **Students can model problems in analysis and studied in this course. Moreover, they are can methods.** **Students can model problems in analysis and studied in this course. Moreover, they are can methods.** **Students are able to discover and verify further studied in the course.** **Students are able to work together in teams common language.** **It doing so, they can communicate new conce partners. Moreover, they can design examples peers.** **Students are capable of checking their underst can specify open questions precisely and know a student part of the presidence and specify open questions precisely and know a student part of the presidence and specify open questions precisely and know a student part of the presidence and specify open questions precisely and know a student part of the presidence and specify open questions precisely and know a student part of the presidence and specify open questions precisely and now a student part of the presidence and presid | tation Section (small) ure tation Section (small) tation Section (large) | 1 2 1 | 2 |
| Linear Algebra II (L0915) Linear Algebra II (L0916) Linear Algebra II (L0917) Module Responsible Admission Requirements Recommended Previous Knowledge Educational Objectives Professional Competence Students can name further concepts in analysis them using appropriate examples. Students can discuss logical connections be illustrating these connections with the help of example of the course. Students can model problems in analysis and studied in this course. Moreover, they are can methods. Students are able to discover and verify further studied in the course. For a given problem, the students can develop to critically evaluate the results. Personal Competence Social Competence Students are able to work together in teams common language. In doing so, they can communicate new concepartners. Moreover, they can design examples peers. Students are capable of checking their underst can specify open questions precisely and students have developed sufficient persistence. Students are capable of checking their underst can specify open questions precisely and structure and suited to precisely and structure and specify open questions precisely and species and specify open questions precisely and specific precisely | tation Section (small) tation Section (large) | 1 | 1 |
| Linear Algebra II (L0917) Module Responsible Prof. Anusch Taraz Admission Requirements Recommended Previous Knowledge Educational Objectives After taking part successfully, students have reached the subject of the | tation Section (large) | | • |
| Module Responsible Prof. Anusch Taraz Admission Requirements Recommended Previous Knowledge Educational Objectives After taking part successfully, students have reached the Professional Competence Students can name further concepts in analysis them using appropriate examples. Students can discuss logical connections be illustrating these connections with the help of exemption They know proof strategies and can reproduce in the course. Students can model problems in analysis and studied in this course. Moreover, they are can methods. Students are able to discover and verify further studied in the course. For a given problem, the students can develop to critically evaluate the results. Personal Competence Social Competence Students are able to work together in teams common language. In doing so, they can communicate new conce partners. Moreover, they can design examples peers. Students are capable of checking their underst can specify open questions precisely and surfacient prec | | 1 | 1 |
| Admission Requirements Recommended Previous Knowledge Educational Objectives Professional Competence Students can name further concepts in analysis them using appropriate examples. Students can discuss logical connections be illustrating these connections with the help of examples. They know proof strategies and can reproduce to the studied in this course. Moreover, they are can methods. Students are able to discover and verify further studied in the course. For a given problem, the students can develop to critically evaluate the results. Personal Competence Social Competence Students are able to work together in teams common language. In doing so, they can communicate new conce partners. Moreover, they can design examples peers. Students are capable of checking their underst can specify open questions precisely and known a student say and equations of precisely and known as students are capable of checking their underst can specify open questions precisely and known as students are capable of checking their underst can specify open questions precisely and known as students have developed sufficient and store. | ∋ following learning | | |
| Recommended Previous Knowledge Educational Objectives Professional Competence Students can name further concepts in analysis them using appropriate examples. Students can discuss logical connections be illustrating these connections with the help of examples and can reproduce in this course. Moreover, they are can methods. Skills Skills Personal Competence Social Competence Students are able to discover and verify further studied in the course. For a given problem, the students can develop to critically evaluate the results. Students are able to work together in teams common language. In doing so, they can communicate new conce partners. Moreover, they can design examples peers. Students are capable of checking their underst can specify open questions precisely and known. Students are capable of checking their underst can specify open questions precisely and known. Students have developed sufficient persistance. | e following learning | | |
| Previous Knowledge Educational Objectives After taking part successfully, students have reached the | e following learning | | |
| Professional Competence Students can name further concepts in analysis them using appropriate examples. Students can discuss logical connections be illustrating these connections with the help of examples and can reproduce to the studied in this course. Moreover, they are can methods. Students are able to discover and verify furth studied in the course. For a given problem, the students can develop to critically evaluate the results. Personal Competence Students are able to work together in teams common language. In doing so, they can communicate new conce partners. Moreover, they can design examples peers. Students are capable of checking their underst can specify open questions precisely and know a Students have developed sufficient persistence. | e following learning | | |
| Students can name further concepts in analysis them using appropriate examples. Students can discuss logical connections be illustrating these connections with the help of exit illustrating the exit in analysis and studied in this course. Students are able to discover and verify further studied in the course. Students are able to discover and verify further studied in the course. Students are able to discover and verify further studied in the course. Students are able to discover and verify further studied in the course. Students are able to discover and verify further studied in the course. Students are able to discover and verify further studied in the course. Students are able to discover and verify further studied in the course. Students are able to discover and verify further studied in the course. Students are able to discover and verify further studied in the course. Students are able to discover and verify further studied in the course. Students are able to discover and verify further studied in the course. Students are able to discover and verify further studied in the course. Students are able to discover and verify further studied in the course. Students are able to discover and verify further studied in the course. Students are able to discover and verify further studied in the course. Students are able to discover and verify further studied in the course. S | | results | |
| them using appropriate examples. Students can discuss logical connections be illustrating these connections with the help of examples. They know proof strategies and can reproduce the studied in this course. Moreover, they are can methods. Students are able to discover and verify further studied in the course. For a given problem, the students can develop to critically evaluate the results. Personal Competence Students are able to work together in teams common language. In doing so, they can communicate new conce partners. Moreover, they can design examples peers. | | | |
| studied in this course. Moreover, they are cap methods. Students are able to discover and verify furth studied in the course. For a given problem, the students can develop to critically evaluate the results. Personal Competence Students are able to work together in teams common language. In doing so, they can communicate new conce partners. Moreover, they can design examples peers. Students are capable of checking their underst can specify open questions precisely and know Students have developed sufficient persistence | Students can name further concepts in analysis and linear algebra. They are able to explain them using appropriate examples. Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. They know proof strategies and can reproduce them. | | |
| Students are able to work together in teams common language. In doing so, they can communicate new conce partners. Moreover, they can design examples peers. Students are capable of checking their underst can specify open questions precisely and know | Students are able to discover and verify further logical connections between the concepts studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able | | |
| common language. In doing so, they can communicate new conce partners. Moreover, they can design examples peers. Students are capable of checking their underst can specify open questions precisely and know students have developed sufficient persistance. | | | |
| can specify open questions precisely and know | | | |
| Autonomy oriented manner on hard problems. | ots according to the | needs of th | eir cooperatir |
| Workload in Hours Independent Study Time 128, Study Time in Lecture 11 | ots according to the to check and deeper anding of complex complex to get help in | e needs of th n the unders concepts on n solving the | eir cooperatir standing of the their own. The m. |
| | ots according to the to check and deeper anding of complex c where to get help in to be able to work for the control of the co | e needs of th n the unders concepts on n solving the | eir cooperatir standing of the their own. The m. |
| Credit points 8 | ots according to the to check and deeper anding of complex c where to get help in to be able to work for the control of the co | e needs of th n the unders concepts on n solving the | eir cooperatir standing of the their own. The m. |
| Studienleistung None | ots according to the to check and deeper anding of complex c where to get help in to be able to work for the control of the co | e needs of th n the unders concepts on n solving the | eir cooperatir standing of the their own. The m. |
| Examination Written exam | ots according to the to check and deeper anding of complex c where to get help in to be able to work for the control of the co | e needs of th n the unders concepts on n solving the | eir cooperatir standing of the their own. The m. |
| Examination duration | ots according to the to check and deeper anding of complex c where to get help in to be able to work for the control of the co | e needs of th n the unders concepts on n solving the | eir cooperatir standing of the their own. The m. |



| and scale | 60 min (Analysis II) + 60 min (Linear Algebra II) |
|--|---|
| Assignment for the Following Curricula | General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Core qualification: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory |

| Course L1025: Analysis | II. |
|------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH |
| Language | DE |
| Cycle | SoSe |
| Content | power series and elementary functions interpolation integration (proper integrals, fundamental theorem, integration rules, improper integrals, parameter dependent integrals applications of integration (volume and surface of bodies of revolution, lines and arc length, line integrals numerical quadrature periodic functions |
| Literature | http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html |

| Course L1026: Analysis II | |
|---------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Course L1027: Analysis II | | |
|---------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L0915: Linear Al | gebra II | | |
|-------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Anusch Taraz, Prof. Marko Lindner | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | general vector spaces: subspaces, Euclidean vector spaces linear mappings: basis transformation, orthogonal projection, orthogonal matrices, householder matrices linear regression: normal equations, linear discrete approximation eigenvalues: diagonalising matrices, normal matrices, symmetric and Hermite matrices system of linear differential equations matrix factorizations: LR-decomposition, QR-decomposition, Schur decomposition, Jordan normal form, singular value decomposition | | |
| Literature | T. Arens u.a.: Mathematik, Spektrum Akademischer Verlag, Heidelberg 2009 W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 G. Strang: Lineare Algebra, Springer-Verlag, 2003 G. und S. Teschl: Mathematik für Informatiker, Band 1, Springer-Verlag, 2013 | | |



| Course L0916: Linear Al | gebra II |
|-------------------------|--|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Anusch Taraz, Prof. Marko Lindner |
| Language | DE |
| Cycle | SoSe |
| Content | linear mappings: basis transformation, orthogonal projection, orthogonal matrices, householder matrices linear regression: QR-decomposition, normal equations, linear discrete approximation eigenvalues: diagonalising matrices, normal matrices, symmetric and Hermite matrices, Jordan normal form, singular value decomposition system of linear differential equations |
| Literature | W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 |

| Course L0917: Linear Algebra II | |
|---------------------------------|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Anusch Taraz, Prof. Marko Lindner, Dr. Christian Seifert |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | |
|---|---|---|--------|--------|
| Title | | Тур | Hrs/wk | СР |
| Technical Thermodynamics | | Lecture | 2 | 4 |
| Technical Thermodynamics Technical Thermodynamics | | Recitation Section (large) Recitation Section (small) | 1 | 1 1 |
| - | | necitation Section (smail) | 1 | 1 |
| Admission | Prof. Gerhard Schmitz | | | |
| Requirements | None | | | |
| Previous Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the following learning results | | | |
| Professional Competence | | | | |
| Knowledge | Students are familiar with different cycle processes like Joule, Otto, Diesel, Stirling, Seiliger and Clausius-Rankine. They are able to derive energetic and exergetic efficiencies and know the influence different factors. They know the difference between anti clockwise and clockwise cycles (heat-power cycle, cooling cycle). They have increased knowledge of steam cycles and are able to draw the different cycles in Thermodynamics related diagrams. They know the laws of gas mixtures, especially of humid air processes and are able to perform simple combustion calculations. They are provided with basic knowledge in gas dynamics and know the definition of the speed of sound and know about a Laval nozzle. | | | |
| Skills | Students are able to use thermodynamic laws for the design of technical processes. Especially the are able to formulate energy, exergy- and entropy balances and by this to optimise technical processes. They are able to perform simple safety calculations in regard to an outflowing gas from a tank. They are able to transform a verbal formulated message into an abstract formal procedure. | | | |
| Personal Competence | | | | |
| Social Competence | The students are able to discuss in small g | roups and develop an approach | | |
| Autonomy | Students are able to define independently tasks, to get new knowledge from existing knowledge as well as to find ways to use the knowledge in practice. | | | |
| Workload in Hours | Independent Study Time 124, Study Time | n Lecture 56 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | | | | |
| Examination duration and scale | 90 min | | | |
| Assignment for the Following Curricula | General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Core qualification: Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory | | | |



Technomathematics: Core qualification: Elective Compulsory Process Engineering: Core qualification: Compulsory

| Course L0449: Technica | Il Thermodynamics II |
|------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. Gerhard Schmitz |
| Language | DE |
| Cycle | WiSe |
| Content | 8. Cycle processes 7. Gas - vapor - mixtures 10. Open sytems with constant flow rates 11. Combustion processes 12. Special fields of Thermodynamics |
| Literature | Schmitz, G.: Technische Thermodynamik, TuTech Verlag, Hamburg, 2009 Baehr, H.D.; Kabelac, S.: Thermodynamik, 15. Auflage, Springer Verlag, Berlin 2012 Potter, M.; Somerton, C.: Thermodynamics for Engineers, Mc GrawHill, 1993 |

| Course L0450: Technical Thermodynamics II | | |
|---|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Gerhard Schmitz | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L0451: Technical Thermodynamics II | | |
|---|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Gerhard Schmitz | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0959: Me | echanics III (Hydro | statics, Kinematics | s, Kinetics I) | | |
|-----------------------------------|--|--|------------------------------------|-------------|------------------|
| Courses | | | | | |
| Title | | | Тур | Hrs/wk | СР |
| , , | , Kinematics, Kinetics I) (L11 | • | Lecture | 3 | 3 |
| | , Kinematics, Kinetics I) (L11 | | Recitation Section (small) | 2 | 2 |
| Mechanics III (Hydrostatics | , Kinematics, Kinetics I) (L11 | (36) | Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof. Robert Seifried | | | | |
| Admission Requirements | | | | | |
| Recommended Previous Knowledge | Mathematics I, II, Mecha | nics I (Statics) | | | |
| Educational Objectives | After taking part success | fully, students have reach | ned the following learning | results | |
| Professional | | | | | |
| Competence | ¦ | | | | |
| Knowledge | The students can describe the axiomatic procedure used in mechanical contexts; explain important steps in model design; present technical knowledge in stereostatics. | | | | |
| Skills | explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems; apply basic hydrostatical, kinematic and kinetic methods to engineering problems; estimate the reach and boundaries of statical methods and extend them to be applicable to wider problem sets. | | | | |
| Personal Competence | | | | | |
| Social Competence | The students can work in | n groups and support eac | h other to overcome difficu | ulties. | |
| Autonomy | Students are capable of and learning based on the | | trengths and weaknesses | and to org | anize their time |
| Workload in Hours | Independent Study Time | 96, Study Time in Lectur | e 84 | | |
| Credit points | 6 | | | | |
| Studienleistung | No 20 % | Form Midterm | Description Wird nur im WiS | e angeboter | 1 |
| Examination | Written exam | | | | |
| Examination duration and scale | 112() min | | | | |
| | General Engineering Sc Mechanical Engineering Mechatronics: Core qua Naval Architecture: Core | ience (German program, g: Core qualification: Com lification: Compulsory e qualification: Compulsor | • | ation: Comp | oulsory |



| Course L1134: Mechanic | cs III (Hydrostatics, Kinematics, Kinetics I) |
|------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Prof. Robert Seifried |
| Language | DE |
| Cycle | WiSe |
| Content | Hydrostatics Kinematics Kinematics of points and relative motion Planar and spatial motion of point systems and rigid bodies Dynamics Terms Fundamental equations Motion of the rigid body in 3D-space Dynamics of gyroscopes, rotors Realtive kinetics Systems with non-constant mass |
| Literature | K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 3 und 4. 11. Auflage, Springer (2011). |

| Course L1135: Mechanics III (Hydrostatics, Kinematics, Kinetics I) | | |
|--|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Robert Seifried | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L1136: Mechanics III (Hydrostatics, Kinematics, Kinetics I) | | |
|--|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Robert Seifried | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0853: Ma | athematics III | | | |
|-----------------------------------|---|---|-------------|------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Analysis III (L1028) | | Lecture | 2 | 2 |
| Analysis III (L1029) | | Recitation Section (small) | 1 | 1 |
| Analysis III (L1030) | | Recitation Section (large) | 1 | 1 |
| • • • | dinary Differential Equations) (L1031) | Lecture | 2 | 2 |
| | dinary Differential Equations) (L1032) | Recitation Section (small) | 1 | 1 |
| • | dinary Differential Equations) (L1033) | Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof. Anusch Taraz | | | |
| Admission Requirements | INone | | | |
| Recommended Previous Knowledge | I Mathematice L ± II | | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Students can name the basic conceare able to explain them using appressible. Students can discuss logical conribustrating these connections with them. They know proof strategies and can | opriate examples. nections between these conce ne help of examples. | | |
| Skills | Students can model problems in the area of analysis and differential equations with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods. Students are able to discover and verify further logical connections between the concepts studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results. | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to work together common language. In doing so, they can communicate partners. Moreover, they can design peers. | new concepts according to the | needs of th | neir cooperating |
| Autonomy | Students are capable of checking the can specify open questions precisel Students have developed sufficient oriented manner on hard problems. | y and know where to get help in | solving the | m. |
| Workload in House | Independent Study Time 129 Study Time in | a Lecture 112 | | |
| | Independent Study Time 128, Study Time in | I LECIUIE I IZ | | |
| Credit points Studienleistung | <u>-</u> | | | |
| Studienieistung | INOTIC | | | |
| Examination | Written exam | | | |
| Examination duration | | | | |
| | I | | | |



| and scale | 60 min (Analysis III) + 60 min (Differential Equations 1) |
|---|---|
| Assignment for the Following Curricula | l General Engineering Science (English program): Core qualification: Compulsory |

| Course L1028: Analysis | III |
|------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH |
| Language | DE |
| Cycle | WiSe |
| Content | Main features of differential and integrational calculus of several variables Differential calculus for several variables Mean value theorems and Taylor's theorem Maximum and minimum values Implicit functions Minimization under equality constraints Newton's method for multiple variables Double integrals over general regions Line and surface integrals Theorems of Gauß and Stokes |
| - Literature | http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html |

| Course L1029: Analysis III | | |
|----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Course L1030: Analysis III | |
|----------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L1031: Different | ial Equations 1 (Ordinary Differential Equations) | |
|-------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Main features of the theory and numerical treatment of ordinary differential equations Introduction and elementary methods Exsitence and uniqueness of initial value problems Linear differential equations Stability and qualitative behaviour of the solution Boundary value problems and basic concepts of calculus of variations Eigenvalue problems Numerical methods for the integration of initial and boundary value problems Classification of partial differential equations | |
| Literature | http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html | |

| Course L1032: Differential Equations 1 (Ordinary Differential Equations) | | |
|--|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Course L1033: Differential Equations 1 (Ordinary Differential Equations) | |
|--|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M1273: Ad | Ivanced Internship GES |
|-----------------------------------|---|
| Courses | |
| Title | Typ Hrs/wk CP |
| Module Responsible | Prof. Gerhard Schmitz |
| Admission Requirements | None |
| Recommended Previous Knowledge | 150 ECTS Credits in General Engineering Science |
| Educational Objectives | After taking part successfully, students have reached the following learning results |
| Professional Competence | |
| Knowledge | Students of the different specialisations get experiences in typical scope of duties of engineers, who are working in a development division, planning division or in the management of a company. In the framework of this environment the knowledge from university can used a first time for real engineering tasks. |
| Skills | Students of the different specialisations should be integrated in typical day's work. By this they are learning typical tasks and functions of engineers. They are able to structure and organize their working day and to finish tasks in a certain time. |
| Personal Competence | |
| Social Competence | Students are able to cooperate with co-workers in a company and to understand the language of engineers. |
| Autonomy | Students can finish own tasks. |
| Workload in Hours | Independent Study Time 540, Study Time in Lecture 0 |
| Credit points | 18 |
| Studienleistung | None |
| Examination | Written elaboration (accord. to Internship Regulations) |
| Examination duration and scale | see Internship Regulations |
| _ | General Engineering Science (German program, 7 semester): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Core qualification: Compulsory |



Specialization Civil Engineering

In the specialization "civil engineering" the graduates attain the basic competences to plan, build and repair structures like bridges and tunnels, structures in hydraulic engineering, as well as industrial and housing construction. The specialization allows the transition to the master program civil engineering.

| Module M0580: Pri | inciples of Building Materials a | nd Building Physics | | |
|--|--|--|--------------|-----------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Building Physics (L0217) | | Lecture | 2 | 2 |
| Building Physics (L0219) | | Recitation Section (large) | 1 | 1 |
| Building Physics (L0247) | | Recitation Section (small) | 1 | 1 |
| Principles of Building Materia | als (L0215) | Lecture | 2 | 2 |
| Module Responsible | Prof. Frank Schmidt-Döhl | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Knowledge of physics, chemistry and mat | hematics from school | | |
| Educational Objectives | After taking part successfully, students have | ve reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The students are able to identify fundamental effects of action to materials and structures, to explain different types of mechanical behaviour, to describe the structure of building materials and the correlations between structure and other properties, to show methods of joining and of corrosion processes and to describe the most important regularities and properties of building materials and structures and their measurement in the field of protection against moisture, coldness, fire and noise. | | | |
| Skills | The students are able to work with the most important standardized methods and regularities in the field of moisture protection, the German regulation for energy saving, fire protection and noise protection in the case of a small building. | | | |
| Personal Competence | | | | |
| Social Competence | The students are able to support each other to learn the very extensive specialist knowledge. | | | |
| Autonomy | The students are able to make the timing and the operation steps to learn the specialist knowledge o a very extensive field. | | | |
| Workload in Hours | Independent Study Time 96, Study Time in | n Lecture 84 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 2 h written exam | | | |
| Assignment for the Following Curricula | General Engineering Science (Germengeneering: Compulsory General Engineering Science (German Compulsory Civil- and Environmental Engineering: Compulsory General Engineering Science (English procompulsory General Engineering Science (English Compulsory Technomathematics: Specialisation III. Engineering III. Engi | program, 7 semester): Special re qualification: Compulsory ogram): Specialisation Civil- and program, 7 semester): Special | lisation Civ | ril Engineering |



| Course L0217: Building Physics | | |
|--------------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Frank Schmidt-Döhl | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Heat transport, thermal bridges, balances of energy consumption, German regulation for energy saving, heat protection in summer, moisture transport, condensation moisture, protection against mold, fire protection, noise protection | |
| Literature | Fischer, HM.; Freymuth, H.; Häupl, P.; Homann, M.; Jenisch, R.; Richter, E.; Stohrer, M.: Lehrbuch der Bauphysik. Vieweg und Teubner Verlag, Wiesbaden, ISBN 978-3-519-55014-3 | |

| Course L0219: Building Physics | |
|--------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Frank Schmidt-Döhl |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L0247: Building Physics | | |
|--------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Frank Schmidt-Döhl | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Course L0215: Principles of Building Materials | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Frank Schmidt-Döhl | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Structure of building materials Effects of action Fundamentals of mechanical behaviour Principles of metals Joining methods Corrosion | |
| Literature | Wendehorst, R.: Baustoffkunde. ISBN 3-8351-0132-3 Scholz, W.:Baustoffkenntnis. ISBN 3-8041-4197-8 | |



| Modulo M0740: St | ruotural Analysis I | | | | |
|-----------------------------------|---|--|--------------------------------|-----------------|-----------------|
| Module M0740: Str | iucturai Ariaiysis i | | | | |
| Courses | | | | | |
| Title | | | Тур | Hrs/wk | СР |
| Structural Analysis I (L0666) |) | | Lecture | 2 | 3 |
| Structural Analysis I (L0667) |) | | Recitation Section (large) | 2 | 3 |
| Module Responsible | Prof. Uwe Starossek | | | | |
| Admission Requirements | INOne | | | | |
| Recommended Previous Knowledge | Mechanics I, Mathematic | es I | | | |
| Educational Objectives | After taking part success | fully, students have reach | ed the following learning | results | |
| Professional Competence | | | | | |
| Knowledge | After successfully comp analysis of statically dete | leting this module, stude erminate systems. | ents can express the bas | sic aspects | of linear frame |
| Skills | determinate and indeter | etion of this module, the rminate structures. They a Ily determinate plane and | are able to analyze state | variables a | - |
| Personal Competence | | | | | |
| - | Students can | | | | |
| Social Competence | participate in subject-specific and interdisciplinary discussions, defend their own work results in front of others promote the scientific development of colleagues Furthermore, they can give and accept professional constructive criticism | | | | |
| Autonomy | The students are able work in-term homework assignments. Due to the in-term feedback, they are enabled to self-assess their learning progress during the lecture period, already. | | | dback, they are | |
| Workload in Hours | Independent Study Time | e 124, Study Time in Lectu | re 56 | | |
| Credit points | 6 | | | | |
| | Compulsory Bonus | Form | Description | | |
| Studienleistung | No 10 % | Written elaboration | Hausübungen Studentische Tu | | |
| Examination | Written exam | | | | |
| Examination duration and scale | 90 Minuten | | | | |
| | General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory | | | | |



| Course L0666: Structural Analysis I | | |
|-------------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Uwe Starossek | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Statically determinate structural systems basics: statically determinacy, equilibrium, method of sections forces: determination of support reactions and internal forces influence lines of forces displacements: calculation of discrete displacements and rotations, calculation of deflection curves principle of virtual displacements and virtual forces work-engergy theorem differential equation of beam | |
| Literature | Krätzig, W.B., Harte, R., Meskouris, K., Wittek, U.: Tragwerke 1 - Theorie und Berechnungsmethoden statisch bestimmter Stabtragwerke. 4. Aufl., Springer, Berlin, 1999. | |

| Course L0667: Structural Analysis I | | |
|-------------------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Uwe Starossek | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0590: Bu | ıilding Materials aı | nd Building Chem | istrv | | |
|--|--|-----------------------------|--|---------|----|
| | . | 3 | , | | |
| Courses | | | | | |
| Title | | | Тур | Hrs/wk | СР |
| Building Materials and Buildin | ng Chemistry (L0248) | | Lecture | 4 | 4 |
| Building Materials and Buildin | ng Chemistry (L0249) | | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Frank Schmidt-Dör | nl | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | Module Principles of Bu | ilding Materials and Buil | ding Physics | | |
| Educational Objectives | After taking part success | sfully, students have read | ched the following learning | results | |
| Professional | | | | | |
| Competence | | | | | |
| Knowledge | most important characte | | rtant components, the mar I behaviour and the corros puilding materials. | | |
| Skills | The students are able to assess the usability of building materials for different applications and to select building materials according to their specific advantages and disadvantages. The students are able to prepare the mixture of a normal type concrete and to consider the mixture in respect to the actual rules and the connections between the characteristic concrete parameters. They are able to select suitable materials and mixtures to avoid damage processes. | | | | |
| Personal Competence | | | | | |
| Social Competence | The students are able to support each other to learn the very extensive specialist knowledge in learning groups and to carry out exercises in small groups in the lab. | | | | |
| Autonomy | The students are able to make the timing and the operation steps to learn the specialist knowledge of a very extensive field. | | | | |
| Workload in Hours | Independent Study Time | e 110, Study Time in Lec | ture 70 | | |
| Credit points | 6 | | | | |
| Studienleistung | No 10 % | Form Presentation | Description | | |
| Examination | Written exam | | | | |
| Examination duration and scale | 2 h written exam | | | | |
| Assignment for the Following Curricula | Compulsory Civil- and Environmenta | al Engineering: Core qua | ram, 7 semester): Specia lification: Compulsory am, 7 semester): Specia | | |



| Course L0248: Building Materials and Building Chemistry | | |
|---|--|--|
| Тур | Lecture | |
| Hrs/wk | 4 | |
| СР | 4 | |
| Workload in Hours | Independent Study Time 64, Study Time in Lecture 56 | |
| Lecturer | Prof. Frank Schmidt-Döhl | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Cementing materials, aggregates, admixtures and other components in mortar and concrete, concrete, durability of cement bonded materials, repair of concrete structures, steel, cast iron, non-ferrous metals, metal corrosion, timber, plastics, natural stone, synthetic stones, mortar, masonry, glass, bitumen | |
| Literature | Wendehorst, R.: Baustoffkunde. ISBN 3-8351-0132-3 Scholz, W.:Baustoffkenntnis. ISBN 3-8041-4197-8 Henning, O.; Knöfel, D.: Baustoffchemie. ISBN 3-345-00799-1 Knoblauch, H.; Schneider, U.: Bauchemie. ISBN 3-8041-5174-4 | |

| Course L0249: Building Materials and Building Chemistry | | |
|---|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Frank Schmidt-Döhl, Klaus-Dieter Henk | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0706: Ge | otechnics I | | | |
|-----------------------------------|--|---|--------------|------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Soil Mechanics (L0550) | | Lecture | 2 | 2 |
| Soil Mechanics (L0551) | | Recitation Section (large) | 2 | 2 |
| Soil Mechanics (L1493) | | Recitation Section (small) | 2 | 2 |
| Module Responsible | Prof. Jürgen Grabe | | | |
| Admission Requirements | None | | | |
| | Modules : | | | |
| Recommended Previous Knowledge | Mechanics I-II | | | |
| Educational Objectives | After taking part successfully, students have re- | ached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The students know the basics of soil mechal distribution due to weight, water or structures failure of the soil due to ground- or slope failure | , consolidation and settleme | | |
| Skills | After the successful completion of the module properties and to evaluate them with the he stresses and deformation in the soils due to prove the usability (settlements) for shallow for | lp of geotechnical standard weight or influence of struc | tests. The | y can calculate |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lec | ture 84 | | |
| Credit points | 6 | | | |
| Studienleistung | Compulsory Bonus Form No 20 % Attestation | Description | | |
| Examination | Written exam | | | |
| Examination duration and scale | 60 minutes | | | |
| _ | General Engineering Science (German Engeneering: Compulsory General Engineering Science (German procompulsory Civil- and Environmental Engineering: Core question General Engineering Science (English program Compulsory General Engineering Science (English program Compulsory Technomathematics: Specialisation III. Engineering | gram, 7 semester): Special alification: Compulsory m): Specialisation Civil- and gram, 7 semester): Special | lisation Civ | ril Engineering: |



| Course L0550: Soil Mechanics | | |
|------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Jürgen Grabe | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Structure of the soil Ground surveying Compsitition and properties of the soil Groundwater One-dimensional compression Spreading of stresses Settlement calculation Consolidation Shear strength Earth pressure Slope failure Ground failure Suspension based earth tenches | |
| Literature | Vorlesungsumdruck, s. ww.tu-harburg.de/gbt Grabe, J. (2004): Bodenmechanik und Grundbau Gudehus, G. (1981): Bodenmechanik Kolymbas, D. (1998): Geotechnik - Bodenmechanik und Grundbau Grundbau-Taschenbuch, Teil 1, aktuelle Auflage | |

| Course L0551: Soil Mechanics | |
|------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Jürgen Grabe |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L1493: Soil Mechanics | |
|------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Jürgen Grabe |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M0613: Re | inforced Concrete I | | | |
|---|---|----------------------------|-------------------|--------------------|
| Courses | | | | |
| Title Project Seminar Concrete I Reinforced Concrete Design | | Typ Seminar Lecture | Hrs/wk 1 2 | CP 1 3 |
| Reinforced Concrete Design | n I (L0305) | Recitation Section (large) | 2 | 2 |
| Module Responsible | Prof. Günter Rombach | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Basic knowledge in structural analysis and buildin | g materials. | | |
| Educational Objectives | After taking part successfully, students have reach | ed the following learning | results | |
| Professional | | | | |
| Competence | The students can cutting the history of consect | a acceptance and avala | in the besi | aa af atuu atuu al |
| Knowledge | The students can outline the history of concrete engineering, including usual load combinations dimension simple structures, as well as to evaluate structural members. | and safety concepts. The | hey are ab | le to draft and |
| Skills | The students are able to apply basic procedures of the conception and dimensioning to practical cases. They are capable to draft simple concrete structures and to design them for bending and bending with axial force, and to plan their detailing and execution. Moreover, they can make design and construction sketches and draw up technical descriptions. | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | The students are able to carry out simple tasks in t critically reflect the results. | he conception and dimen | sioning of s | ructures and to |
| Workload in Hours | Independent Study Time 110, Study Time in Lectu | re 70 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 120 minutes | | | |
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Civil- and Enviromental Engeneering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Civil- and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory | | | |



| Course L0896: Project Seminar Concrete I | |
|--|--|
| Тур | Seminar |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Günter Rombach |
| Language | DE |
| Cycle | SoSe |
| Content | In the course of the project seminar, a simple structure is drafted and dimensioned. |
| Literature | Download der Unterlagen zur Vorlesung über Stud.IP! |

| Course L0303: Reinforced Concrete Design I | | |
|--|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Günter Rombach | |
| Language | DE | |
| Cycle | SoSe | |
| Content | history of concrete construction mechanical and physical-chemical properties od concrete and steel bond between concrete and reinforcement concepts for dimensioning, limit state models, structural safety design of linear members for tension and bending with and without axial force | |
| Literature | Download der Unterlagen zur Vorlesung über Stud.IP! | |

| Course L0305: Reinforced Concrete Design I | |
|--|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Günter Rombach |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | | |
|-----------------------------------|---|---|---|-------------|----------------|
| Γitle | | | Тур | Hrs/wk | СР |
| Structural Analysis II (L0673 | | | Lecture | 2 | 3 |
| Structural Analysis II (L0674 | 1 | | Recitation Section (large) | 2 | 3 |
| | Prof. Uwe Starossek | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | - Cturretrue Analys | | | | |
| Educational Objectives | After taking part success | sfully, students have rea | ched the following learning | results | |
| Professional | | | <u>-</u> | | |
| Competence | <u> </u> | | udents can express the ba | sic aspects | of linear fran |
| Knowledge | | | | | |
| Skills | construct influence lines | | e students are able to ana e plane and spatial frame a | | |
| Personal Competence | | | | | |
| | Students can | | | | |
| Social Competence | defend their ownpromote the scie | bject-specific and interdi n work results in front of c entific development of co ey can give and accept p | others | icism | |
| Autonomy | enabled to self-assess t | | rk assignments. Due to the uring the lecture period, alr | | dback, they a |
| Workload in Hours | Independent Study Time | e 124, Study Time in Led | cture 56 | | |
| Credit points | 6 | | | | |
| Studienleistung | No 10 % | Form Written elaboration | Description Hausübungen Studentische Tu | | |
| Examination | Written exam | | | | |
| Examination duration | 90 Minuten | | | <u></u> | |



| | General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: |
|---------------------|---|
| Assignment for the | Compulsory |
| Following Curricula | Civil- and Environmental Engineering: Core qualification: Compulsory |
| 3 | General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: |
| | Compulsory |

| Course L0673: Structural Analysis II | | |
|--------------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Uwe Starossek | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Linear structural analysis: statically indeterminate systems force method slope-deflection method for sway and non-sway frames general displacement method and finite element method | |
| Literature | Krätzig, W. B.; Harte, R.; Meskouris, K.; Wittek, U.: Tragwerke 2 - Theorie und Berechnungsmethoden statisch unbestimmter Stabtragwerke, 4. Auflage, Berlin, 2004 | |

| Course L0674: Structural Analysis II | |
|--------------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Uwe Starossek |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Modulo Mocaa, Cu | ool Ctruoturoo I | | | | |
|---|---|--|---------------|----------------|--|
| Module M0611: Sto | eei Structures i | | | | |
| Courses | | | | | |
| Title | | Тур | Hrs/wk | СР | |
| Steel Structures I (L0299) | | Lecture | 2 | 3 | |
| Steel Structures I (L0300) | | Recitation Section (large) | 2 | 3 | |
| Module Responsible | Prof. Marcus Rutner | | | | |
| Admission Requirements | INone | | | | |
| Recommended Previous Knowledge | , | nistry | | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | | |
| Professional Competence | | | | | |
| | After passing this module students are able to | 0 | | | |
| | give a summary of the security concept | | | | |
| Knowledge | explain the priciples of the design process describe and illustrate the bhaviour of memers in tension, compression and bending | | | | |
| | describe and indistrate the briaviour of memers in tension, compression and bending | | | | |
| | Students can rate and apply the material stee | el appropiately with respect to i | ts properties | and usage. | |
| Skills | They can use the security concept with respe | ect to loads, forces and resistan | ces. | | |
| They can check the ultimate limit state and the serviceability of simple members compression and bending. | | | | ers in tension | |
| Personal Competence | | | | | |
| Social Competence | After participation of an optional course (building of a simple truss) they are able to organize themselves in groups. They will be successful in guided building a truss with bolted connections according to design drawings. | | | | |
| Autonomy | | | | | |
| | Independent Study Time 124, Study Time in | Lecture 56 | | | |
| Credit points | <u> </u> | | | | |
| Studienleistung | | | | | |
| | Written exam | | | | |
| Examination duration and scale | 1120 minutes | | | | |
| Assignment for the Following Curricula | | rogram, 7 semester): Specia qualification: Compulsory am): Specialisation Civil- and | lisation Civ | il Engineering | |



| Course L0299: Steel Str | uctures I |
|-------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Marcus Rutner |
| Language | DE |
| Cycle | WiSe |
| Content | Introduction to steel constructions Materials Design and security model Tension rods Beams (elsatic and plastic design Column design Bolted connections |
| Literature | Petersen, C.: Stahlbau, 4. Auflage 2013, Springer-Vieweg Verlag Wagenknecht, G.: Stahlbau-Praxis nach Eurocode 3, Bauwerk-Verlag 2011 Band 1 Tragwerksplanung, Grundlagen Band 2 Verbindungen und Konstruktionen |

| Course L0300: Steel Structures I | | |
|----------------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Marcus Rutner | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0728: Hy | draulic Engineering I | | | |
|--|---|---|--------------|---|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Hydrology (L0909) | | Lecture | 1 | 1 |
| Hydrology (L0956) | | Project-/problem-based Learning | 1 | 2 |
| Hydromechanics (L0615) | | Lecture | 2 | 2 |
| Hydromechanics (L0616) | | Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof. Peter Fröhle | | | |
| Admission Requirements | None | | | |
| Recommended | Mathematics I, II and III | | | |
| Previous Knowledge | Mechanik I und II | | | |
| Educational Objectives | After taking part successfully, students have reach | ed the following learning | results | |
| Professional | | | | |
| Competence | | mo of hydromochani | and budge | oay andst= |
| Knowledge | The students are able to define the basic terms of hydromechanics and hydrology and water management. They are able to derive the basic formulations of i) hydrostatics, ii) kinematics of flow and iii) conservation laws and to describe and quantify the relevant processes of the hydrological water cycle. Besides, the students can describe the main aspects of rainfall-run-off-modelling and contest established reservoir / storage models as well as the concepts of the determination of a unit hydrograph. | | | ematics of flows he hydrological nodelling and of |
| Skills | The students are able to apply the fundamental formulations of hydromechanics to basic practical problems. Besides this, they are able to apply basic hydrological approaches and methods to simply hydrological problems. The students have the capability to exemplarily apply simple reservoir/storage models and a unit-hydrograph to given problems. In addition, the basic concepts of field — measurements of hydrological and hydrodynamic values can be described and the students are able to perform, analyze and assess respective measurements. | | | ethods to simple eservoir/storage amic values can |
| Personal Competence | | | | |
| Social Competence | The students are able to prepare and present technical presentations for given topics in groups. | | | n groups. |
| Autonomy | Students can provide each other with feedback a reflecting their study techniques and learning stra | | - | / are capable of |
| Workload in Hours | Independent Study Time 110, Study Time in Lectu | ire 70 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| | The duration of the examination is 2 hours. The examination is 2 hours. | | with respe | ct to the general |
| Assignment for the Following Curricula | understanding of the lecture contents and calcular General Engineering Science (German pro Engeneering: Compulsory General Engineering Science (German progra Compulsory Civil- and Environmental Engineering: Core quali General Engineering Science (English program): Compulsory General Engineering Science (English progra Compulsory | ogram): Specialisation m, 7 semester): Specia fication: Compulsory Specialisation Civil- and | lisation Civ | vil Engineering: |



| Course L0909: Hydrolog | у |
|------------------------|--|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Peter Fröhle |
| Language | DE |
| Cycle | WiSe |
| Content | Introduction to basics of Hydrology: |
| Literature | Maniak, Hydrologie und Wasserwirtschaft, Eine Einführung für Ingenieure, Springer Skript Hydrologie und Gewässerkunde |

| Course L0956: Hydrolog | av . |
|------------------------|--|
| | Project-/problem-based Learning |
| Hrs/wk | |
| CP | |
| | Independent Study Time 46, Study Time in Lecture 14 |
| | Prof. Peter Fröhle |
| Language | DE |
| Cycle | WiSe |
| Content | Introduction to basics of Hydrology: |
| Literature | Maniak, Hydrologie und Wasserwirtschaft, Eine Einführung für Ingenieure, Springer Skript Hydrologie und Gewässerkunde |



| Course L0615: Hydrome | chanics |
|-----------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Peter Fröhle |
| Language | DE |
| Cycle | WiSe |
| Content | Characteristics of fluids Hydrostatics Kinematics of flows, laminar and turbulent flows Conservation laws Conservation of mass Conservation of Energy Momentum Equation Application of conservation laws to flow conditions |
| Literature | Skript zur Vorlesung Hydromechanik/Hydraulik, Kapitel 1-2 E-Learning Werkzeug: Hydromechanik und hydraulik (Link): (http://www.tu-harburg.de/ hydraulik_tool/index.html) Truckenbrodt, E.: Lehrbuch der angewandten Fluidmechanik, Springer Verlag, Berlin, 1998. Truckenbrodt, E.: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide / Fluidmechanik, Springer Verlag, Berlin, 1996. |

| Course L0616: Hydromechanics | | |
|------------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Peter Fröhle | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | | | |
|--|--|---------------------|----------------------|---------------------------------------|---------------|-----------------|
| Γitle | | | | Тур | Hrs/wk | СР |
| ntroduction to Control Syste ntroduction to Control Syste | , , | | | Lecture Recitation Section (small) | 2 2 | 4 2 |
| Module Responsible | Prof. Herber | t Werner | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous Knowledge | - | tion of signals and | systems in time ar | nd frequency domain, Lap | lace transfor | rm |
| Educational Objectives | After taking | part successfully, | students have read | hed the following learning | results | |
| Professional Competence | | | | | | |
| Knowledge | Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequency response They can explain issues arising when controllers designed in continuous time domain are implemented digitally | | | | | |
| Skills | Students can transform models of linear dynamic systems from time to frequency domain an vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus an frequency response techniques They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks | | | | | |
| Personal Competence | | | | | | |
| Social Competence | | | groups to jointly so | olve technical problems, | and experim | nentally valida |
| Autonomy | their controller designs Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress. | | | | | |
| Workload in Hours | Independen | t Study Time 124. | Study Time in Lect | ure 56 | | |
| Credit points | ļ | | | | | |
| Studienleistung | | | | | | |
| Examination | | n | | | | |
| Examination duration and scale | | | | | | |



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

General Engineering Science (English program): Core qualification: Compulsory

Assignment for the General Englowing Curricula Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory



Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective

Compulsory

Process Engineering: Core qualification: Compulsory

| Course L0654: Introduct | ion to Control Systems |
|-------------------------|--|
| Тур | Lecture |
| Hrs/wk | |
| СР | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. Herbert Werner |
| Language | DE |
| Cycle | WiSe |
| Content | Signals and systems Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle Root locus techniques Root locus design of PID controllers Frequency response techniques Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Time delay systems Root locus and frequency response of time delay systems Smith predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools Introduction to Mattab, Simulink, Control toolbox |
| Literature | Computer-based exercises throughout the course Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems' Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010 |



| Course L0655: Introduction to Control Systems | | |
|---|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Herbert Werner | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0628: Wa | ater Management | | | |
|--|--|--------------------------------|---------------|----------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Groundwater Hydrology (LC | 251) | Lecture | 1 | 1 |
| Groundwater Hydrology (LC | • | Recitation Section (large) | 1 | 2 |
| Water Management and Wa | | Lecture | 2 | 3 |
| Module Responsible | | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Mathemaics I to III; Water Engineering I, Che | emistry | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Students are able to define terms of the hydrologic cycle and also parameters to identify the wat quality. Typical aquifer types and the occurring flow and storage processes can be explained technically. They are able to derive the Darcy law and the mathematical description of flow processes as well as their solution. They are in a position to explain the physical background of well hydraulic Fundamentals of solute transport can be reflected. | | | |
| Skills | Students are able to use fundamental relationships of hydrology and water management for th solution of practical issues. They are in a position to rate water quality data and to set up hydrological water balances. They are able to construct ground water contour lines and streamlines on the basis of head data. They have the ability to analyse data of hydraulic field and lab tests to determine hydraulic conductivities and storage coefficients. | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to help each other solving | case studies. | | |
| Autonomy | Are not imparted in this module. | | | |
| Workload in Hours | Independent Study Time 124, Study Time in | Lecture 56 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 120 min | | | |
| Assignment for the Following Curricula | General Engineering Science (German p Elective Compulsory Civil- and Environmental Engineering: Core | | llisation Civ | /il Engineerin |

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering:

Following Curricula

Elective Compulsory



| Course L0251: Groundwater Hydrology | | |
|-------------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Wilfried Schneider | |
| Language | DE | |
| Cycle | WiSe | |
| | Hydrologic water bilance, aquifertyps, groundwater velocities, Darcy law, groundwater contour lines, storage capacity, flow equation, pumping tests, method of Beyer, solute transport in groundwater | |
| Literature | Todd; K. (2005): Groundwater Hydrology Fetter, C.W. (2001): Applied Hydrogeology Hölting & Coldewey (2005): Hydrogeologie Charbeneau, R.J. (2000): Groundwater Hydraulics and pollutant Transport | |

| ourse L0252: Groundwater Hydrology | | |
|------------------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Wilfried Schneider | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L0366: Water Ma | anagement and Water Quality | | |
|------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Mathias Ernst | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | The lecture water Management and water quality provides knowledge on the local and global water cycle. Content overview: • Water balance, water availability, water scarcity, water recycling • Water quality parameter (organic, inorganic), assessment and decision support tools. | | |
| Literature | Teil Wasserwirtschaft: • Wasserwirtschaft, Maniak, Ulrich., Berlin [u.a.]: Springer, 2001 • Wasser; Grohmann, Andreas N Berlin [u.a.]: de Gruyter, 2011 • Pdf der Vorlesung | | |



| Courses | | | | | |
|---|---|---|------------------------------------|----------------|------------------|
| Title | 24) | | Тур | Hrs/wk | СР |
| Computer Engineering (L0321) Computer Engineering (L0324) | | | Lecture Recitation Section (small) | 3 1 | 4 2 |
| Module Responsible | Prof. Heiko Falk | | | | |
| Admission | None | | | | |
| Requirements | Basic knowledge in elec | trical engineering | | | |
| Recommended | The successful comple examination according to | etion of the labs will be the following rules: | e honored during the | | |
| Previous Knowledge | marks due to the respectively, up to | e successful labs, such to the next-better grade. | that the examination's m | arks are lifte | |
| Educational Objectives | After taking part success | fully, students have reac | hed the following learning | g results | |
| Professional Competence | | | | | |
| Knowledge | This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-level programming down to gates. The module includes the following topics: • Introduction • Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks • Sequential logic: Flip-flops, automata, systematic hardware design • Technological foundations • Computer arithmetic: Integer addition, subtraction, multiplication and division • Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining • Memories: Memory hierarchies, SRAM, DRAM, caches • Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physical composition of computer systems. The students can analyze, how highly specific and individual computers can be built based on a collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers of today's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical computer system and the software executed on it. In particular, they shall understand the consequences that the execution of software has on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to propose feasible options. | | | | |
| Personal Competence | | | | | |
| Social Competence | Students are able to solv | re similar problems alone | e or in a group and to pre | sent the resu | Its accordingly. |
| Autonomy | Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. | | | | |
| Workload in Hours | Independent Study Time | 124, Study Time in Lect | ure 56 | | |
| Credit points | 6 | | | | |
| | Compulsory Bonus | Form | Description | | |



| Examination duration and scale | 90 minutes, contents of course and labs |
|--------------------------------|---|
| | General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: |
| | Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: |
| | Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Energy and |
| | Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: |
| | Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Materials in Engineering Sciences: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Energy Systems: Compulsory |
| | Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory |
| = | General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: |
| 1 Ollowing Out Hould | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: |
| | Compulsory Constal Engineering Science (English program 7 competer): Specialization Floatrical Engineering: |
| | General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental |
| | Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Materials in Engineering Sciences: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Energy Systems: Compulsory |



Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory

| Course L0321: Compute | er Engineering | | |
|-----------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | | | |
| СР | 4 | | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | | |
| Lecturer | Prof. Heiko Falk | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output | | |
| Literature | A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. | | |

| Course L0324: Computer Engineering | | |
|------------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0631: Co | oncrete Structures II | | | |
|--|---|--|------------------|-----------------|
| Courses | | | | |
| Title Project Concrete Structures II (L0894) Concrete Structures II (L0348) Concrete Structures II (L0349) | | Typ Project Seminar Lecture Recitation Section (large) | Hrs/wk 1 2 | CP 1 3 2 |
| Module Responsible | Prof. Günter Rombach | | | |
| Admission Requirements | | | | |
| Recommended Previous Knowledge | Knowledge of loads on structures and combination of actions Basics of safety format are required. Knowledge in design of beams and columns for ultimate limit state Lecture 'Concrete Structures I' | | | |
| Educational Objectives | After taking part successfully, students have rea | ched the following learning | results | |
| Professional | | | | |
| Competence | | | | |
| Knowledge | The students know the basic principles which arev required for design of reinforced concrete structures. They know the various methods to estimate the member forces in simple one and two-way slabs. | | | |
| Skills | The students can design reinforced concrete structure in the ultimate limit state (shear, bending, torsion) and in the serviceability limit state (crack and deflection control) including detailing (anchorage and links etc.). The students can estimate the member forces of simple slabs. The students know the content and the layout of a structural analysis | | | |
| Personal Competence | | | | |
| Social Competence | Cooperation in a project work, where they design in a team a real concrete building and present the results at the end. | | | |
| Autonomy | | | | |
| | Independent Study Time 110, Study Time in Led | ture 70 | | |
| Credit points | 1 | | | |
| Studienleistung | | | | |
| - | Written exam | | | |
| Examination duration and scale | l 120 minutes | | | |
| Assignment for the Following Curricula | It ivii- and Environmental Engineering, those difallification, thombilisory | | | |



| Course L0894: Project Concrete Structures II | | |
|--|---|--|
| Тур | Project Seminar | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Günter Rombach | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Design of a truss structure | |
| Literature | Skript zur Lehrveranstaltung "Stahlbetonbau II" | |

| Course L0348: Concrete | Structures II | | |
|------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Günter Rombach | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Design of concrete members for shear, punching and torsion Design for serviceability limit state (durability): crack- and deflection control Detailing Introduction in the design of plates Layout and content of a structural design | | |
| Literature | Vorlesungsumdrucke König G., Tue N.: Grundlagen des Stahlbetonbaus. Teubner Verlag, Stuttgart 1998 Zilch K., Zehetmaier G.: Bemessung im konstruktiven Betonbau. Springer Verlag, 2010 Deutscher Beton- und Bautechnikverein E.V.: Beispiele zur Bemessung von Betontragwerken nach Eurocode 2. Band 1: Hochbau, Bauverlag GmbH, Wiesbaden 2011 Dahms KH.: Rohbauzeichnungen, Bewehrungszeichnungen. Bauverlag, Wiesbaden 1997 Grasser E., Thielen G.: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken. Deutscher Ausschuss für Stahlbeton, Heft 240, Verlag Ernst & Sohn, Berlin 1978 DIN EN 1992-1-1:2011: Bemessung und Konstruktion von Stahlbeton- und Spannbetontragwerken - Teil 1: Allgemeine Bemessungsregeln für den Hochbau. | | |

| Course L0349: Concrete Structures II | | |
|--------------------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Günter Rombach | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0755: Ge | eotechnics II | | | |
|--|---|---|------------------------------|-----------------|
| Courses | | | | |
| Title Foundation Engineering (L05) Foundation Engineering (L05) Foundation Engineering (L14) | 553) | Typ Lecture Recitation Section (large) Recitation Section (small) | Hrs/wk 2 2 2 | CP 2 2 2 |
| Module Responsible | Prof. Jürgen Grabe | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Modules: • Mechanics I-II • Geotechnics I | | | |
| Educational Objectives | After taking part successfully, students have reach | ed the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The students know the basic principles and methods which are required to verificate the stability of geotechnical structures. After successful completion of the module the students are able to: | | | |
| Skills | verificate the stability and usability of foundations | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture | e 84 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 60 minutes | | | |
| _ | General Engineering Science (German pro Engeneering: Compulsory General Engineering Science (German progra Elective Compulsory Civil- and Environmental Engineering: Core qualif General Engineering Science (English program): Compulsory General Engineering Science (English prograf Elective Compulsory Technomathematics: Specialisation III. Engineering | m, 7 semester): Specia fication: Compulsory Specialisation Civil- and m, 7 semester): Specia | lisation Civi Enviromenta | il Engineering: |



| Course L0552: Foundation Engineering | | |
|--------------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Jürgen Grabe | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Shallow foundations Pile foundations Ground improvement Retaining walls Underpinning Groundwater Conservation Cut-off Walls | |
| Literature | Vorlesung/Übung s. www.tu-harburg.de/gbt Grabe, J. (2004): Bodenmechanik und Grundbau Kolymbas, D. (1998): Geotechnik - Bodenmechanik und Grundbau Grundbau-Taschenbuch, neueste Auflage | |

| Course L0553: Foundation Engineering | | |
|--------------------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Jürgen Grabe | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L1494: Foundation Engineering | | |
|--------------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Jürgen Grabe | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0878: | Applications in | Civil and | Environmental | Engineering |
|---------------|-----------------|-----------|----------------------|--------------------|
|---------------|-----------------|-----------|----------------------|--------------------|

| | phications in Civil and Envil | <u> </u> | | |
|-----------------------------------|--|--|---------------|------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | CP |
| Applied Numerical Methods | | Seminar | 3 | 3 |
| Applied Structural Dynamics | s (L0791) | Lecture | 2 | 2 |
| Building Information Modelin | g (L1903) | Lecture | 1 | 1 |
| Building Information Modelin | g (L1904) | Project-/problem-based Learning | 2 | 2 |
| Computational Analysis of S | tructures (L0370) | Lecture | 2 | 3 |
| ntroduction in Statitics with | R (L0286) | Lecture | 1 | 1 |
| ntroduction in Statitics with | R (L0776) | Recitation Section (large) | 1 | 1 |
| Principles of Geomatics (L0 | 470) | Lecture | 2 | 2 |
| Principles of Geomatics (L0 | 471) | Recitation Section (small) | 2 | 2 |
| Numeric and Matlab (L0125 |) | Practical Course | 2 | 2 |
| Practical Course in Drinking | Water Chemistry (L1744) | Practical Course | 1 | 2 |
| Projects II (L1228) | , | Project Seminar | 2 | 2 |
| Fire Protection and Preventi | on (L0472) | Lecture | 2 | 2 |
| Module Responsible | NN . | | | |
| Admission | | | | |
| Requirements | | | | |
| Recommended Previous Knowledge | INONA | | | |
| Educational Objectives | After taking part successfully, students | s have reached the following learning | results | |
| Professional | | | | |
| Competence | | | | |
| | ! ! | typical applications of the study progra | mmo | |
| Knowledge | | sypical applications of the study progre | annic. | |
| | | | | |
| | The students are able to use the methods that are provided during the lectures for practical question. They are able to work in the learnt methods into new forms of application independently." | | | |
| | | | aoponaona, | , . |
| ~ ···· | | | | |
| Skills | | | | |
| | | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| | According to the course chosen stud- | ents are able to perform tasks or to co | anduct a nro | niect in teams |
| Social Competence | so, they can present, discuss and doc | | Jiluuci a pic | jeci iii leaiiis |
| ocoidi competence | So, they can present, discuss and doc | differit results accordingly. | | |
| | According to the course chosen indi | vidual students can plan and docum | ent tasks ar | nd work flow |
| Autonomy | themselves or for the team. | Tradar clade into carr prair and accum | o | |
| ŕ | | | | |
| Workload in Hours | Depends on choice of courses | | | |
| Credit points | 6 | | | |
| | General Engineering Science (Ger | man program 7 semester). Specia | lisation Civ | il Engineeri |
| | Elective Compulsory | man program, / semester). Specia | maaiion GIV | Lugineelli |
| Assignment for the | Civil- and Environmental Engineering | r: Core qualification: Compulsory | | |
| Following Curricula | _ = | ilish program, 7 semester): Specia | lisation Civ | il Engineeri |
| | Floative Compulsory | , program, / comostor). Opecia | | gccm |

Elective Compulsory





| Course L0791: Applied S | Structural Dynamics | |
|--------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Examination Form | Mündliche Prüfung | |
| Examination duration and scale | 15 min | |
| Lecturer | Dr. Kira Holtzendorff | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Induced vibrations Impact excitations of structures Methods of amplitude reduction (vibration isolation) Introduction to soil dynamics Vibration measurements and requirements for vibration protection Vibrations induced by people | |
| Literature | Helmut Kramer: Angewandte Baudynamik, Ernst & Sohn Verlag, 2. Auflage 2013 Christian Petersen: Dynamik der Baukonstruktionen, Vieweg Verlag, 2. Auflage von 2000 | |



| Course L1903: Building Information Modeling | | |
|---|---|--|
| Тур | Lecture | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Examination Form | Schriftliche Ausarbeitung | |
| Examination duration and scale | siehe Modulhandbuch | |
| Lecturer | Prof. Frank Schmidt-Döhl | |
| Language | DE | |
| Cycle | WiSe/SoSe | |
| Content | Designing of basic drawing elements (e. g. line, circle, arc,) Modifying of construction elements (e. g. copy, mirror, extend, trim, fillet,) Administration and use of the program structure Dimensioning of design and structural elements Inscribing of design and structural elements Hatching of structural elements Creating and preparing of printable drawings Aims and procedure of building information modeling | |
| Literature | - | |

| Course L1904: Building Information Modeling | | |
|---|---|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| | Schriftliche Ausarbeitung | |
| Examination duration and scale | siehe Modulhandbuch | |
| Lecturer | Prof. Frank Schmidt-Döhl | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Course L0370: Computational Analysis of Structures | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Examination Form | | |
| Examination duration and scale | 60 min | |
| Lecturer | Prof. Günter Rombach | |
| Language | DE | |
| Cycle | WiSe | |
| Content | basics of the Finite Element Method, Spreadsheets basics of software 'SOFiSTiK' modeling of an arbitrary cross-section modeling of an arbitrary 2D truss structure incl. loads Teddy; usage of global and local variables design of a concrete section modeling of a T-beam bridge by means of a grillage system modeling and design of a rectangular slab building models | |
| Literature | Skript zu Vorlesung Tutorials von SOFiSTiK Rombach G.: Anwendung der Finite - Elemente - Methode im Betonbau. 2. Auflage. Verlag Ernst &.Sohn, Berlin, 2007 Rombach G.: Finite-Element Design of Concrete Structures. 2nd edition, ICE Publishing, London, 2011, ISBN 0 7277 32749 Rombach G.: EDV-unterstützte Berechnungen im Stahlbetonbau. in: "Stahlbetonbau aktuell 2014" (ed. Gorris A., Hegger J., Mark P.), Berlin 2014 (S. C1C.36) | |



| | ion in Statitics with R |
|--------------------------------|--|
| | Lecture |
| Hrs/wk | |
| СР | - |
| | Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | |
| Examination duration and scale | 60 min |
| Lecturer | Dr. Joachim Behrendt |
| Language | DE |
| Cycle | WiSe |
| | Introduction to R |
| | Graphics with R |
| | Descriptive Statistic (Boxplot, Percentiles, outliers) |
| | Propability (Combinatorics, relative frequency, dependand probability) |
| Content | random numbers and distributions (confidence interval, uniform and discrete distributions, test distributions (t-F-X²-distribution)) |
| | Correlation and Regression analysis (Confidence interval of calibration curves, linearity) |
| | Statistic test procedures (mean value-t-Test, Chi^2-Test, F-Test) |
| | Analysis of variance (ANOVA, Bartlett-Test, Kruskal-Wallis Rank sum test) |
| | Introduction time series (tseries) |
| | Introduction cluster analysis (k-means) |
| | Regionales Rechenzentrum für Niedersachsen |
| | Statistik mit R Grundlagen der Datenanalyse |
| | , 2013 |
| | Finführung in die Statistik mit D. Andrese Handl. Skript I lei Biolefold |
| | Einführung in die Statistik mit R, Andreas Handl, Skript Uni Bielefeld http://www.wiwi.uni-bielefeld.de/fileadmin/emeriti/frohn/handl_grundausbildung/statskript.pdf |
| Literature | und die dazugehörige Aufgabensammlung http://www.wiwi.uni-bielefeld.de/fileadmin/emeriti/frohn/handl_grundausbildung/statauf.pdf |
| | Induktive Statistik [Elektronische Ressource] : eine Einführung mit R und SPSS / Helge von Toutenburg, Helge 2008 |
| | http://dx.doi.org/10.1007/978-3-540-77510-2http://dx.doi.org/10.1007/978-3-540-77510-2 |
| | R-Referenzcard: http://cran.r-project.org/doc/contrib/Short-refcard.pdfhttp://cran.project.org/doc/contrib/Short-refcard.pdf |
| | Grafiken und Statistik in R von Andreas Plank Nachschlage Skript mit Beispielen: http://www.geo.fu berlin.de/geol/fachrichtungen/pal/mitarbeiter/plank/Formeln_in_R.pdfhttp://www.geo.fu- berlin.de/geol/fachrichtungen/pal/mitarbeiter/plank/Formeln_in_R.pdf |



| Course L0776: Introduction in Statitics with R | | |
|--|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Examination Form | | |
| Examination duration and scale | siehe Vorlesung | |
| Lecturer | Dr. Joachim Behrendt | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L0470: Principle | s of Geomatics |
|--------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Examination Form | Schriftliche Ausarbeitung |
| Examination duration and scale | schriftliche Ausarbeitungen zu allen fünf Übungen, ggf. Testklausur |
| Lecturer | Prof. Peter Andree |
| Language | DE |
| Cycle | SoSe |
| Content | Overview of geomatics in general Units of measurements Generating of topographical maps Basic surveying instruments and handling Geodetic surveying lines and verification of measurements Methods of horizontal survey Components of geodetic surveying instruments Height determination Setting out points Topographical survey Directions and angles Determination of coordinates Traversing Basics on surveying and positioning with GNSS |
| Literature | Andree, P.: Grundlagen der Geomatik (Skript) Resnik, B. / Bill, R.: Vermessungskunde für den Planungs- Bau- und Umweltbereich, Wichmann-verlag Witte, B. / Sparla, P.: Vermessungskunde und Grundlagen der Statistik für das Bauwesen, Wichmann-Verlag Gruber, F.J. / Joeckel, R.: Formelsammlung für das Vermessungswesen, Vieweg + Teubner-Verlag |



| Course L0471: Principle | Course L0471: Principles of Geomatics | | | | |
|-------------------------|---|--|--|--|--|
| Тур | Recitation Section (small) | | | | |
| Hrs/wk | 2 | | | | |
| СР | 2 | | | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | | | |
| Examination Form | Schriftliche Ausarbeitung | | | | |
| Examination duration | | | | | |
| and scale | • | | | | |
| Lecturer | Prof. Peter Andree | | | | |
| Language | DE | | | | |
| Cycle | SoSe | | | | |
| Content | See interlocking course | | | | |
| Literature | See interlocking course | | | | |

| Course L0125: Numeric | and Matlab |
|--------------------------------|--|
| Тур | Practical Course |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Examination Form | Fachtheoretisch-fachpraktische Arbeit |
| Examination duration and scale | 5 Übungsaufgaben jeweils mit Testat am Ende |
| Lecturer | Prof. Siegfried Rump, Weitere Mitarbeiter |
| Language | DE |
| Cycle | SoSe |
| Content | Programming in Matlab Numerical methods for systems of nonlinear equations Basics in computer arithmetic Linear and nonlinear optimization Condition of problems and algorithms Verified numerical results with INTLAB |
| Literature | Literatur (Software-Teil): 1. Moler, C., Numerical Computing with MATLAB, SIAM, 2004 2. The Math Works, Inc., MATLAB: The Language of Technical Computing, 2007 3. Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de 4. Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005 |



| Course L1744: Practical | Course in Drinking Water Chemistry |
|--------------------------------|---|
| Тур | Practical Course |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| | Fachtheoretisch-fachpraktische Arbeit |
| Examination duration and scale | 6 Versuchsprotokolle |
| Lecturer | Dr. Klaus Johannsen |
| Language | DE |
| Cycle | WiSe |
| Content | IMax.12 students! The students learn basic experimental work in the laboratory. The experiments give an overview about the most important chemical analysis methods of drinking water. This includes sampling, photometric measurement, complexometric titration as well as acid/base titration. The experiments are strongly related to the processes in drinking water treatment and water distribution (e. g. removal of iron and manganese, softening and conditioning). Instrumental analytics is not subject of this practical course. 1. Day: Introduction, safety instructions 2. Day: Electrical conductivity, Saturation with respect to calcite, hardness 3. Day: Organic carbon, iron, acid and base neutralization capacity 4. Day: Writing protocols of experiments 5. Day: Evaluation of the protocols |
| Literature | Siehe Skript. See Script. |

| Course L1228: Projects | II | |
|------------------------|--|--|
| Тур | Project Seminar | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Examination Form | | |
| Examination duration | ca. zehnminütige Präsentation | |
| and scale | Sa. 25mmmaago 1 1aosmaasii | |
| Lecturer | Prof. Jürgen Grabe | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Excursions to different construction and environmental projects. | |
| Literature | keine | |



| Course L0472: Fire Prot | ection and Prevention | | | | |
|--------------------------------|--|--|--|--|--|
| Тур | Lecture | | | | |
| Hrs/wk | 2 | | | | |
| СР | 2 | | | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | | | |
| Examination Form | | | | | |
| Examination duration and scale |) min | | | | |
| Lecturer | ndreas Kattge | | | | |
| Language | DE | | | | |
| Cycle | SoSe | | | | |
| Content | Introduction fire in residential and office buildings town planning: location of residential, office and industry areas, location of fire stations design of roads an water pipes explosions | | | | |
| Literature | Schneider U.: Ingenieurmethoden im baulichen Brandschutz. Expert Verlag, 2. Aufl., 2002 | | | | |



| M. J.J. Macaa | | | | | |
|---|--|--|----------------------------|--|--|
| Module M0829: Fo | undations of Management | | | | |
| Courses | | | | | |
| Title | 2) | Typ | Hrs/wk | CP | |
| Management Tutorial (L0882 Introduction to Management | | Recitation Section (large) Lecture | 2 3 | 3 3 | |
| Module Responsible | Prof. Christoph Ihl | | | | |
| Admission Requirements | INANA | | | | |
| Recommended Previous Knowledge | Basic Knowledge of Mathematics and Business | S | | | |
| Educational Objectives | After taking part successfully, students have rea | ached the following learning | results | | |
| Professional Competence | | | | | |
| | After taking this module, students know the im Management, from Planning and Organisation and Controlling. In particular they are able to • explain the differences between Economics of the Eco | n to Marketing and Innovati | on, and also | o to Investmen | |
| Knowledge | Management and to name important definitions from the field of Management explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and human ressource management, information management, innovation management and marketing explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance state basics from accounting and costing and selected controlling methods. | | | | |
| Skills | Students are able to analyse business units w strategies etc.) and to carry out an Entrepreneu analyse Management goals and structue analyse organisational and staff structue apply methods for decision making und analyse production and procurement sy analyse and apply basic methods of masselect and apply basic methods from masselect and apply basic methods from accounting, contact the strategies and apply basic methods from accounting, contact the strategies and apply basic methods from accounting, contact the strategies and apply basic methods from accounting, contact the strategies and apply basic methods from accounting, contact the strategies and apply basic methods from accounting, contact the strategies and apply basic methods from accounting, contact the strategies and apply basic methods from accounting, contact the strategies and accounting the strategies and apply basic methods from accounting, contact the strategies and apply basic methods from accounting, contact the strategies and apply basic methods from accounting, contact the strategies and apply basic methods from accounting, contact the strategies and apply basic methods from accounting, contact the strategies and apply basic methods from accounting, contact the strategies and apply basic methods from accounting the strategies and apply basi | reship project in a team. In particle them appropriately res of companies er multiple objectives, under vistems and Business informatical finance to prede | uncertainty tion system | r are able to and under risk s ms | |
| Personal Competence | | | | | |
| Social Competence | work successfully in a team of students to apply their knowledge from the lectureport on the project to communicate appropriately and to cooperate respectfully with their fellow | | roject and v | rite a coheren | |
| Autonomy | Students are able to work in a team and to organize the team to write a report on their project. | n themselves | | | |
| | Independent Study Time 110, Study Time in Le | cture 70 | | | |
| Credit points | | | | | |
| Studienleistung | | | | | |
| | Subject theoretical and practical work | | | | |
| Examination duration | | | | | |



and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

Assignment for the Following Curricula

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:



Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory

Naval Architecture: Core qualification: Compulsory
Technomathematics: Core qualification: Compulsory
Process Engineering: Core qualification: Compulsory

| Course L0882: Managen | nent Tutorial |
|-----------------------|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Christoph Ihl, Katharina Roedelius, Tobias VIcek |
| Language | DE |
| Cycle | WiSe/SoSe |
| Content | In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools. If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on self-selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the business knowledge from the lecture should come to practical use. The group projects are guided by a mentor. |
| Literature | Relevante Literatur aus der korrespondierenden Vorlesung. |



| urse L0880: Introduct | ion to Management | | | | | | |
|-----------------------|---|--|--|--|--|--|--|
| Тур | Lecture | | | | | | |
| Hrs/wk | 3 | | | | | | |
| СР | 3 | | | | | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | | | | | |
| Lecturer | Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona | | | | | | |
| Language | DE | | | | | | |
| Cycle | WiSe/SoSe | | | | | | |
| Content | Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chair Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects | | | | | | |
| Literature | Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgar 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006. | | | | | | |



| Module M0579: St | ructural Design | | | | | | |
|---|--|--|--|--------------|----------------|--|--|
| Courses | | | | | | | |
| Title Basics of Structural Design Exercises in Structural Design Seminar in Structural Design | ign (L0208) | | Typ Lecture Recitation Section (large) Project-/problem-based Learning | Hrs/wk 2 1 2 | CP 1 1 | | |
| Module Responsible | Dr. Gernod Deckelmann | | | | | | |
| Admission Requirements | INone | | | | | | |
| Recommended Previous Knowledge | Contents of module Prin | | | | | | |
| Educational Objectives | After taking part successf | ully, students have reach | ed the following learning | results | | | |
| Professional Competence | | | | | | | |
| Knowledge | to define the basicto specify typical tto distinguish diffe | After attending the course students are able to define the basics of building regulations law to specify typical building components to distinguish different possibilities of load bearing behaviour and risks due to lack of stability to explain the main objectivs of fire control | | | | | |
| Skills | After attending the course students are able to evaluate development plans and to convert the main objectivs of building regulation laws to a architect's plan to decide which building components should be used to get a correcct building enevelope and a sufficient building stability to proof the moisture behaviour, the energy consumption, the acoustic protection and the fire control of a construction to plot the results of drafts and decisions | | | | | | |
| Personal Competence | ł | e students are able | | | | | |
| Social Competence | After attending the course students are able to work in a team and to persent the results of the team work to use the feedback from other students to improve the own results to give a feedback to other students in a constructive manner | | | | | | |
| Autonomy | After attending the course students are able to control and improve their knowledge with the help of weekly presentations (lecture room) and tests (STUD.IP) to divide the main task in different parts, to deduce the needed knowledge and to schedule the different work steps | | | | | | |
| Workload in Hours | Independent Study Time | 110, Study Time in Lectu | re 70 | | | | |
| Credit points | 6 | | | | | | |
| Studienleistung | Compulsory Bonus Form Description Erarbeiten eines Bauantrags und Teile der Yes 20 % Written elaboration Ausführungsplanung in Gruppenarbeit von 4 Personen | | | | | | |
| Examination | Written exam | | | | | | |
| Examination duration and scale | 160 minutes written test | | | | | | |
| Assignment for the | Compulsory | cience (German progra | m, 7 semester): Specia | lisation Civ | il Engineering | | |



| Following Curricula | Civil- and | d Environment | al Engine | ering: Co | re qualifica | ıtio | n: Compulso | ory | | |
|---------------------|------------|---------------|-----------|-----------|--------------|------|-------------|----------------|-------|--------------|
| | General | Engineering | Science | (English | program, | 7 | semester): | Specialisation | Civil | Engineering: |
| | Compuls | ory | | | | | | | | |

| <u> </u> | f Structural Design | | | | | |
|-------------------|---|--|--|--|--|--|
| Тур | Lecture | | | | | |
| Hrs/wk | 2 | | | | | |
| СР | 1 | | | | | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | | | | | |
| Lecturer | Dr. Gernod Deckelmann | | | | | |
| Language | DE | | | | | |
| Cycle | SoSe | | | | | |
| Content | Basics of building regulation laws Foundation of buildings Sealing of basements facades Ceilings Roofs Windows, doors and post-and-beam constructions Staircases Basics of strucural engineering design Structural fire prevention Optional tests on STUD.IP | | | | | |
| Literature | Neumann, Dietrich (Hestermann, Ulf.; Rongen, Ludwig.; Weinbrenner, Ulrich) Frick/Knöll Baukonstructionslehre 1 / [Internet-Ressource] ISBN: 978-3-8351-9121-1 Wiesbaden: B.G. Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2006 Frick[Begr.], Otto (Knöll[Begr.], Karl.; Neumann, Dietrich.; Hestermann, Ulf.; Rongen, Ludwig.) Baukonstruktionslehre 2 / [Internet-Ressource] ISBN: 978-3-8348-9486-1 Wiesbaden: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 Dierks, Klaus (Wormuth, Rüdiger.) Baukonstruktion: [Einführung, Grundlagen, Gründungen, technische Ausrüstung, Wänd Geschossdecken, Treppen, Dächer, Fenster, Türen, Konstruktionsatlas] ISBN: 3804150454 (Gb.) ISBN: 978-3-8041-5045-4 Neuwied: Werner, 2007 Neufert, Ernst (Kister, Johannes) Bauentwurfslehre: Grundlagen, Normen, Vorschriften über Anlage, Bau, Gestaltung, Raumbeda Raumbeziehungen, Maße für Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Mund Ziel; Handbuch für den Baufachmann, Bauherrn, Lehrenden und Lernend ISBN: 978-3-8348-0732-8 (GB.) | | | | | |



| urse L0208: Exercise | s in Structural Design | | |
|----------------------|--|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| | Dr. Gernod Deckelmann | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Constructing a small individuell building in groups of 4 persons Analysing the informations and the contents of development plans and building regulation laws Design of building components and approving of the funcionality (sealing, facades, roofs) Design and approve of the funcionality of the component interconnections Proofing and assessing of moisture behaviour, energy comsumption, acoustic protection and fire control Assessing the building stabilty Basics of building services Each week the results of different work steps are presented in oral and written form | | |
| Literature | Neumann, Dietrich (Hestermann, Ulf.; Rongen, Ludwig.; Weinbrenner, Ulrich) Frick/Knöll Baukonstructionslehre 1 / [Internet-Ressource] ISBN: 978-3-8351-9121-1 Wiesbaden: B.G. Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2006 Frick[Begr.], Otto (Knöll[Begr.], Karl.; Neumann, Dietrich.; Hestermann, Ulf.; Rongen, Ludwig.) Baukonstruktionslehre 2 / [Internet-Ressource] ISBN: 978-3-8348-9486-1 Wiesbaden: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 Dierks, Klaus (Wormuth, Rüdiger.) Baukonstruktion: [Einführung, Grundlagen, Gründungen, technische Ausrüstung, Wände, Geschossdecken, Treppen, Dächer, Fenster, Türen, Konstruktionsatlas] ISBN: 3804150454 (Gb.) ISBN: 978-3-8041-5045-4 Neuwied: Werner, 2007 Schneider, Klaus-Jürgen (Goris, Alfons.; Berner, Klaus) Bautabellen für Ingenieure: mit Berechnungshinweisen und Beispielen; [auf CD-ROM: Stabwerksprogramm IQ 100 B, Tools für den konstr. Ingenieurbau, Fachinformationen, Normentexte] ISBN: 3804152287 Neuwied: Werner, 2006 Wendehorst, Reinhard (Wetzell, Otto W.,; Baumgartner, Herwig.; Deutsches Institut für Normung) Wendehorst Bautechnische Zahlentafeln ISBN: 978-3-8351-0055-8 ISBN: 3835100556 Stuttgart [u.a.]: Teubner Berlin [u.a.]: Beuth, 2007 Neufert, Ernst (Kister, Johannes) Bauentwurfslehre: Grundlagen, Normen, Vorschriften über Anlage, Bau, Gestaltung, Raumbedarf, Raumbeziehungen, Maße für Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Maß und Ziel; Handbuch für den Baufachmann, Bauherrn, Lehrenden und Lernenden ISBN: 978-3-8348-0732-8 (GB.) Wiesbaden: Vieweg + Teubner, 2009 | | |



| ourse L0209: Seminar | in Structural Design | | |
|----------------------|--|--|--|
| Tvp | Project-/problem-based Learning | | |
| Hrs/wk | | | |
| СР | | | |
| | Independent Study Time 92, Study Time in Lecture 28 | | |
| | Dr. Gernod Deckelmann | | |
| Language | DE | | |
| Cycle | | | |
| Content | Constructing a small individuell building in groups of 4 persons Analysing the informations and the contents of development plans and building regulation laws Design of building components and approving of the funcionality (sealing, facades, roofs) Design and approve of the funcionality of the component interconnections Proofing and assessing of moisture behaviour, energy comsumption, acoustic protection and fire control Assessing the building stabilty Basics of building services Each week the results of different work steps are presented in oral and written form | | |
| Literature | Neumann, Dietrich (Hestermann, Ulf.; Rongen, Ludwig.; Weinbrenner, Ulrich) Frick/Knöll Baukonstructionslehre 1 / [Internet-Ressource] ISBN: 978-3-8351-9121-1 Wiesbaden : B.G. Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2006 Frick[Begr.], Otto (Knöll[Begr.], Karl.; Neumann, Dietrich.; Hestermann, Ulf.; Rongen, Ludwig.) Baukonstruktionslehre 2 / [Internet-Ressource] ISBN: 978-3-8348-9486-1 Wiesbaden : Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008 Dierks, Klaus (Wormuth, Rüdiger.) Baukonstruktion : [Einführung, Grundlagen, Gründungen, technische Ausrüstung, Wände, Geschossdecken, Treppen, Dächer, Fenster, Türen, Konstruktionsatlas] ISBN: 3804150454 (Gb.) ISBN: 978-3-8041-5045-4 Neuwied : Werner, 2007 Schneider, Klaus-Jürgen (Goris, Alfons.; Berner, Klaus) Bautabellen für Ingenieure : mit Berechnungshinweisen und Beispielen ; [auf CD-ROM: Stabwerksprogramm IO 100 B, Tools für den konstr. Ingenieurbau, Fachinformationen, Normentexte] ISBN: 3804152287 Neuwied : Werner, 2006 Wendehorst, Reinhard (Wetzell, Otto W.,; Baumgartner, Herwig.; Deutsches Institut für Normung) Wendehorst Bautechnische Zahlentafeln ISBN: 978-3-8351-0055-8 ISBN: 3835100556 Stuttgart [u.a.] : Teubner Berlin [u.a.] : Beuth, 2007 Neufert, Ernst (Kister, Johannes) Bauentwurfslehre : Grundlagen, Normen, Vorschriften über Anlage, Bau, Gestaltung, Raumbedarf, Raumbeziehungen, Maße für Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Maß und Ziel ; Handbuch für den Baufachmann, Bauherrn, Lehrenden und Lernenden ISBN: 978-3-8348-0732-8 (GB.) Wiesbaden : Vieweg + Teubner, 2009 | | |



| Module M0686: Sa | nitary Engineering | | | |
|---|--|---|-----------------------|-------------------|
| Courses | | | | |
| Title Wastewater Disposal (L027) Wastewater Disposal (L027) Drinking Water Supply (L030) Drinking Water Supply (L030) | B) D6) | Typ Lecture Recitation Section (large) Lecture Recitation Section (large) | Hrs/wk 2 1 2 | CP 2 1 1 2 |
| Module Responsible | Prof. Ralf Otterpohl | | | |
| Admission Requirements | | | | |
| Recommended Previous Knowledge | Basic knowledge on Chemistry and Biolog Hydraulics of pipe systems and open char Basic knowledge on water management: Basic knowledge on Environmental Legisl | nnels water quantity and water q | uality | |
| Educational Objectives | After taking part successfully, students have reach | ned the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The students can examplify their expert knowledge on urban water infrastructures. They can present the derivation and detailed explanation of important standards for the design of drinking water supply and wastewater disposal systems in Germany and they are capable of reproducing the relevant empiricals assumptions and scientific simplifications. The students are able to present and discuss sanitary engineering processes and the technologies used for drinking and wastewater treatment. They can also assess existing problems in the field of sanitary engineering by considering legal, risk and saftey aspects. Furthermore, they know how to draft the features and effectiveness of important technologies of the future such as high- and low-pressure membrane filtration systems and techniques for the removal of trace pollutants. | | | |
| Skills | The students are able to apply the relevant standards and guidelines for the design and operation of urban water infrastructures independently. Their expertise comprises expert skills to design drinking water supply and urban drainage systems as well as the associated treatment facilities. Besides the acquirement of technical skills the students are able to address and solve biochemical problems in the filed of drinking water and wastewater treatment. The students are also able to develop ideas of their own to improve the existing water related infrastructures, systems and concepts. | | | |
| Personal Competence Social Competence | Social skills are not targeted in this module. | | | |
| Autonomy | Students are able to form concepts on their ow Therefore they can acquire appropriate knowled regard to the approach to problems (preparation a | ge when being given som | ne clues or i | |
| Workload in Hours | Independent Study Time 96, Study Time in Lectur | re 84 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | | | | |
| | General Engineering Science (German pro Engeneering: Compulsory | ogram): Specialisation | Civil- and | Enviromental |



| | General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: |
|---------------------|---|
| Assignment for the | Elective Compulsory |
| Following Curricula | Civil- and Environmental Engineering: Core qualification: Compulsory |
| | General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: |
| | Elective Compulsory |

| Course L0276: Wastewater Disposal | | |
|-----------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Ralf Otterpohl | |
| Language | DE | |
| Cycle | SoSe | |
| Content | This lecture focusses on urban drainage and wastewater treatment. Urban Drainage Design of urban drainage systems (combined and separate sewer systems) Special structures Rainwater management Wastewater treatement Mechanical treatment (Screens, Grit chamber, Preliminary Sedimentation, Secondary Settlement Tanks, Membrane Filtration) Biological Treatment (aerobic, anaerobic, anoxic) Special Wastewater Treatment Processes (Ozonation, Adsorption) | |
| Literature | Die hier aufgeführte Literatur ist in der Bibliothek der TUHH verfügbar. The literature listed below is available in the library of the TUHH. Taschenbuch der Stadtentwässerung: mit 10 Tafeln und 67 Tabellen, Imhoff, K., & . (2009). (31., verbesserte Aufl.). Munchen: Oldenbourg Industrieverl. Abwasser: Technik und Kontrolle. Neitzel, Volkmar, and Weinheim [u.a.]: Wiley-VCH, 1998. Kommunale Kläranlagen: Bemessung, Erweiterung, Optimierung, Betrieb und Kosten, (2009). Gunthert, F. Wolfgang: (3., vollig neu bearb. Aufl.). Renningen: expert-Verl. Water and wastewater technology Hammer, M. J. 1., & . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International. Water and wastewater engineering: design principles and practice: Davis, M. L. 1. (2011) New York, NY: McGraw-Hill. Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ. | |

| Course L0278: Wastewater Disposal | |
|-----------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Ralf Otterpohl |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Course L0306: Drinking | Water Supply |
|------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Dr. Klaus Johannsen, Prof. Mathias Ernst |
| Language | DE |
| Cycle | SoSe |
| Content | The lecture on drinking water supply provides students with a basic understanding of the entire water supply system, encompassing water catchment, water treatment including pump systems, water storage, and the distribution system that carries water to the consumer. Initially, basics in hydraulics and pump systems are presented (system curve and pump curve). Students learn how the duty point of the pump is determined. Students learn about different water resources and will be able to design groundwater wells. Students learn how to determine water demand and derive planning values for designing the different elements of a water supply system (e.g., firefighting requirements). The functions of reservoirs, their design and arrangement in the water supply system are explained. Students will be able to design simple water distribution systems. A further part of the lecture deals with the processes involved in drinking water supply. This includes a presentation of the essential mechanisms and layout parameters for sedimentation, filtration coagulation, membrane treatment, adsorption, water softening, gas exchange, ion exchange and disinfection. The basics of process treatment technology will be built on with parallel analysis of the impacts on chemical and physical water quality parameters. |
| Literature | Gujer, Willi (2007): Siedlungswasserwirtschaft. 3., bearb. Aufl., Springer-Verlag. Karger, R., Cord-Landwehr, K., Hoffmann, F. (2005): Wasserversorgung. 12., vollst. überarb. Aufl., Teubner Verlag Rautenberg, J. et al. (2014): Mutschmann/Stimmelmayr Taschenbuch der Wasserversorgung. 16. Aufl., Springer-Vieweg Verlag. DVGW Lehr- und Handbuch Wasserversorgung: Wasseraufbereitung - Grundlagen und Verfahren, m. CD-ROM: Band 6 (2003). |

| Course L0308: Drinking Water Supply | | |
|-------------------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Dr. Klaus Johannsen, Prof. Mathias Ernst | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0869: Hy | draulic Engineering II | | | |
|--|--|---|--------------|------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | CP |
| Hydraulics (L0957) | | Lecture | 1 | 1 |
| Hydraulics (L0958) | | Recitation Section (large) | 1 | 1 |
| Hydraulic Engineering (L095 | | Lecture | 2 | 2 |
| Hydraulic Engineering (L096 | · | Recitation Section (large) | 1 | 2 |
| Module Responsible | Prof. Peter Fröhle | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Hydraulik Engineering I | | | |
| Educational Objectives | After taking part successfully, students have reach | ned the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Students are able to define the basic terms of hydraulic engineering and hydraulics. They are able to explain the application of basic hydrodynamic formulations (conservation laws) to practical hydraulic engineering problems. Besides this, the students can illustrate important tasks of hydraulic engineering and give an overview over river engineering, flood protection, hydraulic power engineering and waterways engineering. | | | |
| Skills | The students are able to apply hydraulic engineering methods and approaches to basic practical problems and design respective hydraulic engineering systems. Besides this, they are able to use and apply established approaches of hydraulics and determine water surfaces of channel flows, influences of constructions (weirs, etc.) on channel flows as well as flow conditions of pipe system. | | | |
| Personal Competence | | | | |
| Social Competence | The students are able to deploy their gained knowledge in applied problems. Additionally, they will be able to work in team with engineers of other disciplines. | | | |
| Autonomy | The students will be able to independently extend | The students will be able to independently extend their knowledge and apply it to new problems. | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lectu | ure 70 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| | The duration of the examination is 2 hours. The e understanding of the lecture contents and calcula | | with respec | ct to the genera |
| Assignment for the Following Curricula | General Engineering Science (German pro Engeneering: Compulsory General Engineering Science (German progra Elective Compulsory Civil- and Environmental Engineering: Core quali General Engineering Science (English program): Compulsory General Engineering Science (English progra | am, 7 semester): Specia ification: Compulsory Specialisation Civil- and | lisation Civ | ril Engineering |

Elective Compulsory



| Course L0957: Hydraulio | cs |
|-------------------------|---|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Peter Fröhle |
| Language | DE |
| Cycle | SoSe |
| Content | Flow of incompressible fluids in pipes and open channels Hydraulics of pipes Punps in hydraulic systems Open channel flow Regulative construction in open channel flow Weirs Sliding panels Cross-section reduction by constructions |
| Literature | Zanke, Ulrich C., Hydraulik für den WasserbauUrsprünglich erschienen unter: Schröder/Zanke "Technische Hydraulik", Springer-Verlag, 2003 Naudascher, E.: Hydraulik der Gerinne und Gerinnebauwerke, Springer, 1992 |

| Course L0958: Hydraulics | | |
|--------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Peter Fröhle | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Course L0959: Hydraulio | c Engineering |
|-------------------------|---|
| | Lecture |
| Hrs/wk | |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Peter Fröhle |
| Language | DE |
| Cycle | SoSe |
| Content | Inland waterways engineering waterways Locks and ship lifts Fish passages Nature-oriented hydraulic engineering |
| Literature | Strobl, T. & Zunic, F: Wasserbau, Springer 2006 Patt, H. & Gonsowski, P: Wasserbau, Springer 2011 |

| Course L0960: Hydraulic Engineering | |
|-------------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Peter Fröhle |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



Specialization Bioprocess Engineering

Biotechnology provides the basics for sustainable manufacturing of products as food, feed, bioenergy, biopolymers and chemicals and for providing the human being wit medicines and other essential goods. It requires interdisciplinary application of natural (especially biology and chemistry) and engineering sciences. Many everyday products are manufactured by means of biotechnical production processes. Biotechnical material conversion is also used to utilize and minimize byproducts and residues in order to achieve sustainable production. Engineers with biotechnical expertise are needed to meet the growing global demand for the development and operation of biotechnical processes by which to manufacture essential everyday products.

Graduates can explain phenomena that occur in bioprocess engineering and allied disciplines. They can outline the basic bioprocess engineering principles for interpreting, modeling, and simulating biological processes and chemical reactions, energy, material, and momentum transport processes, micro-, meso- and macro-scale separation processes, and for operating the plant required for these processes. They are able to describe the basics of measurement and control technology. They can take into consideration legal aspects that arise in connection with process engineering and production facilities.

| Courses | | | | |
|--|--|----------------------------------|-------------------|-----------------|
| Title Introduction into Process Engineering/Bioprocess Engineering (L0829) Fundamentals of material engineering (L0830) | | Typ Lecture Lecture | Hrs/wk 2 2 | CP 1 2 |
| Module Responsible | Prof. Michael Schlüter | | | |
| Admissior Requirements | INone | | | |
| Recommended Previous Knowledge | Inone | | | |
| Educational Objectives | After taking part successfully, students have | reached the following le | arning results | |
| Professiona Competence Knowledge | After passing this module the students have the ability to: • give an overview of the most important fields on process and bioprocess engineering, • explain some working methods for different fields in process engineering. | | | |
| Skills | After passing this module the students should have the ability to: • list and outline the most important fields of process engineering, • name the most important working approaches or methods of the different fields of procengineering, • read and prepare an engineering drawing, • explain the most important technologies for wastewater and exhaust air treatment • scheme typical chemical and biotechnological processes independently with the aid pointers. | | | ent |
| Personal Competence | The students are able to work out results in groups and docu provide appropriate feedback and h | | own performance c | constructively. |



| Autonomy | The students are able to estimate their progress of learning by themselves and to deliberate their lack of knowledge in Process Engineering and Bioprocess Engineering. | | |
|--------------------------------|--|--|--|
| Workload in Hours | Independent Study Time 34, Study Time in Lecture 56 | | |
| Credit points | 3 | | |
| Studienleistung | Compulsory Bonus Form Description Yes None Written elaboration | | |
| | Written exam | | |
| Examination duration and scale | 90 min | | |
| _ | General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Process Engineering: Core qualification: Compulsory | | |

| Course L0829: Introduction into Process Engineering/Bioprocess Engineering | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | |
| Lecturer | Dozenten des SD V | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Introduction into the different research fields of the subject Process Engineering and Bioprocess Engineering. | |
| Literature | s. StudIP | |



| Course L0830: Fundame | entals of material engineering |
|-----------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Marko Hoffmann |
| Language | DE |
| Cycle | WiSe |
| Content | Introduction Atomic structure and bonding Structure of solids Miller indices Imperfections in solids Texture Diffusion Mechanical properties Dislocations and strengthening mechanisms Phase transformations Phase diagrams, iron-carbon phase diagram Metallic materials Corrosion Polymeric materials Ceramic materials |
| Literature | Bargel, HJ.; Schulze, G. (Hrsg.): Werkstoffkunde. Berlin u.a., Springer Vieweg, 2012. Bergmann, W.: Werkstofftechnik 1. München u.a., Hanser, 2009. Bergmann, W.: Werkstofftechnik 2. München u.a., Hanser, 2008. Callister, W. D.; Rethwisch, D. G.: Materialwissenschaften und Werkstofftechnik: eine Einführung, Übersetzungshrsg.: Scheffler, M., 1. Auflage, Weinheim, Wiley-VCH, 2013. Seidel, W. W., Hahn, F.: Werkstofftechnik. München u.a., Hanser, 2012. |



| Courses | | | | |
|--|--|--|--------------------------------------|-------------------------------|
| Title | | Тур | Hrs/wk | СР |
| Physical Chemistry (L0833) Physical Chemistry (L0835) | | Lecture Practical Course | 2 2 | 2 1 |
| Module Responsible | Prof. Hans-Ulrich Moritz | | | |
| Admission Requirements | | | | |
| Recommended Previous Knowledge | Contants of the previous modules inorganic chemistry, physics for engineers and mathematics LIII | | | |
| Educational Objectives | After taking part successfully, students have | reached the following lear | ning results | |
| Professional Competence | | | | |
| | The students are able, | | | |
| | -to repeat the basic concepts of physical ch | emistry | | |
| Knowledge | -to describe and summarize the underlying | concepts of mass-, heat- a | nd momentum tr | ansfer. |
| | - to interpret phase diagrams and affiliate ki | netic rate laws. | | |
| | The students are able to | | | |
| | - conduct (fundamental) thermodynamical, electrochemical and kinetic calculations. | | | |
| Skills | - assess new applications with respect to environmental sustainability. | | | |
| Grane | - abstract their knowldege to related issues to conduct thermodynamical, electrochemical and kinetic | | | |
| | calculations. | s to conduct thermodynami | cai, electrochen | lical and kine |
| Personal Competence | | | | |
| | The students are able to plan, prepare, c guidelines in small groups. | onduct and document exp | eriments accord | ling to scienti |
| Social Competence | The students are able to reflect their subject-specific knowledge orally in a team and to discuss it wit fellow students and faculty. | | | |
| Autonomy | Students are able to assess their knowldege continuously on their own by exemplified practic Students are able to apply their knowldege discretely to plan, prepare and conduct experiments. | | | |
| Workload in Hours | Independent Study Time 34, Study Time in Lecture 56 | | | |
| Credit points | 3 | | | |
| Studionloistuna | Compulsory Bonus Form Subject theo | Description retical and | 1 | |
| Studienleistung | Yes None Subject thec | retical and | | |
| Examination | Written exam | | | |
| Examination duration and scale | 180 min | | | |
| | General Engineering Science (German pro- General Engineering Science (German pro- General Engineering Science (German pro- Compulsory General Engineering Science (German pro- Elective Compulsory | gram): Specialisation Bioprogram, 7 semester): Spec | ocess Engineeri ialisation Proce | ng: Compulso ss Engineerin |
| | Bioprocess Engineering: Core qualification General Engineering Science (English prog General Engineering Science (English prog General Engineering Science (English prog Compulsory General Engineering Science (English prog | ram): Specialisation Proce ram): Specialisation Biopro ogram, 7 semester): Speci | ocess Engineerii ialisation Proce | ng: Compulso ss Engineerir |



Elective Compulsory
Process Engineering: Core qualification: Compulsory

| ourse L0833: Physical Chemistry | | |
|--|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Volker Abetz | |
| Language | DE | |
| Cycle | WiSe | |
| Content State variables and state equations, ideal and real gases, first law, driving force of chemical equilibria, introduction into kinetics of chemical reactions, introduction phenomena, phase equilibria, equilibria at surfaces and interfaces | | |
| Literature | P. W. Atkins, J. de Paula: Physikalische Chemie, 5. Auflage, Wiley-VCH, 2013 P. W. Atkins, J. de Paula: Kurzlehrbuch Physikalische Chemie, 4. Auflage, Wiley-VCH, 2008 G. Wedler, HJ. Freund: Lehrbuch der Physikalischen Chemie, 6. Auflage, Wiley-VCH, 2012 R. Reich: Thermodynamik - Grundlagen u. Anwendungen in der allgemeinen Chemie, 2. Auflage, Wiley-VCH, 1993 U. Nickel: Lehrbuch der Thermodynamik - Eine verständliche Einführung, 2. Auflage, PhysChem-Verlag, 2011 | |



| Course L0 | 835: Physical Chemistry |
|-------------------|--|
| Тур | Practical Course |
| Hrs/wk | 2 |
| СР | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Prof. Volker Abetz |
| Language | DE |
| Cycle | WiSe |
| Content | Six laboratory experiments are conducted in groups of two students. The subjects of experimental investigations are: Reaction kinetics Freezing-point depression (cryoscopy) Electrical mobility of ions Viscosimetry Heat of neutralization Surface tension Before the practical conduct of the experiments a colloquium takes place in which the students explain, reflect and discuss the theoretical basics and their translation into practice. The students write up a report for every experiment. They receive feedback to their level of scientific writing (citation methods, labeling of graphs, etc.), so that they can improve their competence in this field over the course of the practical course. |
| Literature | Skript zum Chemiepraktikum III für Verfahrenstechniker, jeweils aktuelle Version, ca. 100 Seiten, PDF-Datei zum Download unter http://www.chemie.uni-hamburg.de/studium/nebenfach/tuhh3/studium/nebenfach/tuhha/studium/nebenfach/tuhha/studium/nebenfach/tuhha/studium/nebenfach/tuhha/studium/nebenf |



| Recommended Previous Knowledge Educational Objectives A Professional Competence | Prof. Heiko Falk None Basic knowledge in electrical engineering The successful completion of the laberamination according to the following of the successful laberaminary and the successful laberate respectively, up to the next-bette 2. The improvement of the grade 5. After taking part successfully, students here. | bs will be honored during the rules: Ination, the student is granted bs, such that the examination er grade. In a control of the following learness of the functionality of computers. | he evaluation of a bonus on the s's marks are lifted is not possible. | e examination' ed by 0,3 or 0,4 |
|---|--|--|---|--|
| Module Responsible Admission Requirements Recommended Previous Knowledge Educational Objectives Professional Competence | Prof. Heiko Falk None Basic knowledge in electrical engineering The successful completion of the laberamination according to the following in the successful laberamination according to the successful laberate respectively, up to the next-bette 2. The improvement of the grade 5. After taking part successfully, students have the successfully and the successfully are spectively. | Lecture Recitation Section (sr ing bs will be honored during to rules: Ination, the student is granted bs, such that the examination er grade. In our to 4,3 and of 4,3 up to 4,0 that reached the following learns of the functionality of computes | he evaluation of a bonus on the s marks are lifted is not possible. | of the module' e examination' ed by 0,3 or 0,4 |
| Module Responsible F Admission Requirements Recommended Previous Knowledge Educational Objectives A Professional Competence | Prof. Heiko Falk None Basic knowledge in electrical engineering The successful completion of the laberamination according to the following in the successful laberamination according to the successful laberate respectively, up to the next-bette 2. The improvement of the grade 5. After taking part successfully, students have the successfully and the successfully are spectively. | ing bs will be honored during to rules: ination, the student is granted bs, such that the examination er grade. is,0 up to 4,3 and of 4,3 up to 4,0 thave reached the following learns of the functionality of computes | he evaluation of a bonus on the s's marks are lifted is not possible. | of the module e examination ed by 0,3 or 0,4 |
| Admission Requirements Recommended Previous Knowledge Educational Objectives A Professional Competence | Basic knowledge in electrical engineering the successful completion of the laberamination according to the following of the successful laberamination according to the following of the successful laberates and the successful laberates are spectively, up to the next-bette successfully, up to the grade 5. After taking part successfully, students have the successfully and the successfully and the successfully are successfully and the successfully and the successfully are successfully and the successful are successfully are successfully are successfully and the successful are successfully are successfully and the successful are successfully are successfully and the successful are successfully a | bs will be honored during the rules: Ination, the student is granted bs, such that the examination er grade. In a control of the following learness of the functionality of computers. | I a bonus on the smarks are lifted is not possible. | e examination' ed by 0,3 or 0,4 |
| Requirements Recommended Previous Knowledge Educational Objectives Professional Competence | Basic knowledge in electrical engineering the successful completion of the laberamination according to the following of the successful laberaminary and the successful laberament of the grade 5. After taking part successfully, students have the assembly-level programming description. | bs will be honored during the rules: Ination, the student is granted bs, such that the examination er grade. In a control of the following learness of the functionality of computers. | I a bonus on the smarks are lifted is not possible. | e examination ed by 0,3 or 0,4 |
| Recommended Previous Knowledge Educational Objectives A Professional Competence | The successful completion of the laberamination according to the following of the laberamination according to the following of the laberamination according to the following of the laberaminary and the successful laberament of the next-bette successfully, up to the next-bette successfully, and the laberament of the grade 5. After taking part successfully, students have a successfully and the successfully and the successfully are taking part successfully. | bs will be honored during the rules: Ination, the student is granted bs, such that the examination er grade. In a control of the following learness of the functionality of computers. | I a bonus on the smarks are lifted is not possible. | e examination ed by 0,3 or 0,4 |
| Professional Competence | This module deals with the foundations rom the assembly-level programming d | s of the functionality of comput | ing systems. It c | - |
| Competence | rom the assembly-level programming d | | | - |
| | rom the assembly-level programming d | | | - |
| Knowledge | Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis combinational networks Sequential logic: Flip-flops, automata, systematic hardware design | | | |
| Skills A | The students perceive computer systems from the architect's perspective, i.e., they identify the intern structure and the physical composition of computer systems. The students can analyze, how high specific and individual computers can be built based on a collection of few and simple component. They are able to distinguish between and to explain the different abstraction layers of today computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical computer system and the software executed on it. In particular, they sha understand the consequences that the execution of software has on the hardware-centric abstractic layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to proposite easible options. | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to solve similar proble | ems alone or in a group and to | present the resu | ılts accordingly |
| | Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. | | | |
| Workload in Hours | ndependent Study Time 124, Study Tim | me in Lecture 56 | | |
| Credit points | 3 | | | |
| Studienleistung | Compulsory Bonus Form Yes 10 % Excercises | Description | n | |



| Examination duration and scale | 90 minutes, contents of course and labs |
|--------------------------------|---|
| | General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: |
| | Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Energy Systems: Compulsory |
| | Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory |
| | General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Energy Systems: Compulsory |



Computational Science and Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory
Technomathematics: Specialisation II. Informatics: Elective Compulsory

| Course L0321: Compute | r Engineering | | |
|-----------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | | | |
| СР | | | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | | |
| Lecturer | Prof. Heiko Falk | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output | | |
| Literature | A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. | | |

| Course L0324: Computer Engineering | | |
|------------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | | |
|---|---|-----------------------|--------------------------------------|--------------|--------|
| Title | | | Тур | Hrs/wk | СР |
| Fundamentals of Fluid Mechanics (L0091) | | | Lecture Recitation Section (large | 2 ge) 2 | 4 2 |
| Module Responsible | Prof. Michael Schlüter | | | | |
| Admission Requirements | INone | | | | |
| Recommended Previous Knowledge | Mathematics I+II+III Technical Mechanics I+II Technical Thermodynamics I+II Working with force balances Simplification and solving of partial differential equations Integration | | | | |
| Educational Objectives | After taking part succe | ssfully, students hav | e reached the following lear | ning results | |
| Professional Competence | | | | | |
| Knowledge | explain the difference between different types of flow give an overview for different applications of the Reynolds Transport-Theorem in process engineering explain simplifications of the Continuity- and Navier-Stokes-Equation by using physical boundary conditions | | | | |
| Skills | describe and model incompressible flows mathematically reduce the governing equations of fluid mechanics by simplifications to archive quantitative solutions e.g. by integration notice the dependency between theory and technical applications use the learned basics for fluid dynamical applications in fields of process engineering | | | | |
| Personal Competence | | | | | |
| Social Competence | The students are capable to gather information from subject related, professional publications and relate that information to the context of the lecture and able to work together on subject related tasks in small groups. They are able to present their results effectively in English (e.g. during small group exercises) are able to work out solutions for exercises by themselves, to discuss the solutions orally and to present the results. | | | | |
| Autonomy | The students are able to search further literature for each topic and to expand their knowledge with this literature, work on their exercises by their own and to evaluate their actual knowledge with the feedback. | | | | |
| Workload in Hours | Independent Study Tir | ne 124, Study Time | in Lecture 56 | | |
| Credit points | 6 | | | | |
| Studienleistung | Compulsory Bonus Form Description Yes 5 % Midterm | | | | |
| Examination | Written exam | | | | |
| Examination duration and scale | 2 hours | | | | |



| | General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory |
|--|--|
| | General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory |
| Assignment for the Following Curricula | Energy and Environmental Engineering: Core qualification: Compulsory |
| | General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental |
| | Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory |
| | Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Process Engineering: Core qualification: Compulsory |

| Typ Lecture | | | |
|-------------|--|--|--|
| Hrs/wk | | | |
| СР | | | |
| | ndependent Study Time 92, Study Time in Lecture 28 | | |
| | Prof. Michael Schlüter | | |
| Language | | | |
| Cycle | | | |
| Content | fluid properties hydrostatic overall balances - theory of streamline overall balances- conservation equations differential balances - Navier Stokes equations irrotational flows - Potenzialströmungen flow around bodies - theory of physical similarity turbulent flows compressible flows | | |
| Literature | Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluider Springer-Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994. Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematisch Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006. Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömunger Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008. Kuhlmann, H.C.: Strömungsmechanik: München, Pearson Studium, 2007. Oertl, H.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoder Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007. Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgäng dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008. Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212. | | |



| Course L0092: Fluid Med | chanics for Process Engineering | | |
|-------------------------|--|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Michael Schlüter | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | the exercise-lecture the topics from the main lecture are discussed intensively and transferred into pplication. For that, the students receive example tasks for download. The students solve these roblems based on the lecture material either independently or in small groups. The solution is iscussed with the students under scientific supervision and parts of the solutions are presented on the chalk board. At the end of each exercise-lecture, the correct solution is presented on the chalk oard. Parallel to the exercise-lecture tutorials are held where the student solve exam questions under set time-frame in small groups and discuss the solutions afterwards. | | |
| Literature | Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994. Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006. Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008. Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007. Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008. Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011. | | |



| Courses | | | | |
|---|---|---|---|--|
| Title Phase Equilibria Thermodynamics (L0114) Phase Equilibria Thermodynamics (L0140) Phase Equilibria Thermodynamics (L0142) | | Typ Lecture Recitation Section (small Recitation Section (large) | | CP 2 2 2 |
| Module Responsible | | . tooliation coolist (latigo) | · | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | lathematics, Physical Chemistry, Thermodynamics I and II | | | |
| Educational Objectives | After taking part successfully, students ha | ve reached the following learning | g results | |
| Professional Competence | | | | |
| Knowledge | Starting from the very basics of thermodynamics, the students learn the mathematical tools to describe thermodynamic equilibria. They learn how state variables are influenced by the mixing of compounds and learn concept to quantitatively describe these properties. Moreover, the students learn how phase equilibria can be described mathematically and which phenomena may occur if different phases (vapor, liquid, solid) coexist in equilibrian Furthermore the fundamentals of reaction equilibria are taught. For different phase equilibria, several examples relevant for different kinds of processes are shown and the necessary knowledge for plotting and interpreting the equilibria are taught. | | | |
| Skills | Applying their knowledge, the sent determination of the equilibrium st The students know models which equilibrium state and they are ableed. For specific applications, they approperties of compounds as well as Beside pure compound properties mixtures. The students know how to visus interpret the occurring phenomenase. Based on their knowledge, the stuthe basis for many separation and | ate and know how to simplify the can be used to determine the period to solve the resulting mathematic able to self-reliantly find is model parameters in literature is the students are capable of alize phase equilibria graphical. | ese equations roperties of the tical relations necessary personneces. describing the ally and the undamental contents. | s meaningfully he system in the s. hysico-chemic he properties y know how oncepts that a |
| Personal Competence | The students are able to work in small o | roups, to solve the correspond | ing problems | s and to prese |
| Social Competence | them oraly to the tutors and other students | | | · |
| Autonomy | The students are able to find necessary information self-reliantly in literature sources and t judge their quality. During the semester the students are able to check their learning progress continuously i exercises. Based on this knowledge the students can adept their learning process. | | | |
| Workload in Hours | | | | |



| Credit points Studienleistung | Rone |
|----------------------------------|--|
| Examination | Written exam |
| Examination duration and scale | r 120 minules: ineoretical questions and calculations |
| • | General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Compuls |

| • | |
|------------------------|--|
| Course L0114: Phase Ed | quilibria Thermodynamics |
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Irina Smirnova |
| Language | DE |
| Cycle | SoSe |
| Content | Introduction: Applications of thermodynamics of mixtures Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule Equations of state: virial equations, van-der-Waals equation, generalized equations of state Mixing properties: ideal and real mixtures, excess properties, partial molar properties Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition Gas-liquid-equilibria: equilibrium condition, Henry-coefficient G^E-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems Solid-liquid-equilibria: equilibrium condition, binary systems Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature Osmotic pressure |
| Literature | Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992 J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O 'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005. |



| Course L0140: Phase Ed | quilibria Thermodynamics | | | | |
|------------------------|---|--|--|--|--|
| Тур | Recitation Section (small) | | | | |
| Hrs/wk | | | | | |
| СР | 2 | | | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | | | |
| Lecturer | Prof. Irina Smirnova | | | | |
| Language | DE | | | | |
| Cycle | SoSe | | | | |
| Content | Introduction: Applications of thermodynamics of mixtures Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule Equations of state: virial equations, van-der-Waals equation, generalized equations of state Mixing properties: ideal and real mixtures, excess properties, partial molar properties Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition Gas-liquid-equilibria: equilibrium condition, Henry-coefficient G^E-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems Solid-liquid-equilibria: equilibrium condition, binary systems Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature Osmotic pressure The students work on tasks in small groups and present their results in front of all students. | | | | |
| Literature | Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992 J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O 'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005. | | | | |



| Course L0142: Phase Ed | quilibria Thermodynamics | | | | |
|------------------------|--|--|--|--|--|
| Тур | Recitation Section (large) | | | | |
| Hrs/wk | | | | | |
| СР | | | | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | | | |
| Lecturer | Prof. Irina Smirnova | | | | |
| Language | DE | | | | |
| Cycle | SoSe | | | | |
| Content | Introduction: Applications of thermodynamics of mixtures Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule Equations of state: virial equations, van-der-Waals equation, generalized equations of state Mixing properties: ideal and real mixtures, excess properties, partial molar properties Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition Gas-liquid-equilibria: equilibrium condition, Henry-coefficient G^E-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems Solid-liquid-equilibria: equilibrium condition, binary systems Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature Osmotic pressure | | | | |
| Literature | Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992 J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O 'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005. | | | | |



| Module M0757: Bio | ochemistry and Microbiology | | | | | | |
|-----------------------------------|---|---|--|-----------------|--|--|--|
| Courses | | | | | | | |
| Title | | Тур | Hrs/wk | СР | | | |
| Biochemistry (L0351) | | Lecture | 2 | 2 | | | |
| Biochemistry (L0728) | | Project-/problem-based Learning | 1 | 1 | | | |
| Microbiology (L0881) | | Lecture | 2 | 2 | | | |
| Microbiology (L0888) | | Project-/problem-based Learning | 1 | 1 | | | |
| Module Responsible | Dr. Paul Bubenheim | | | | | | |
| Admission Requirements | None | | | | | | |
| Recommended Previous Knowledge | none | | | | | | |
| Educational Objectives | After taking part successfully, students have reach | ned the following learning | results | | | | |
| Professional Competence | | | | | | | |
| 23 | At the end of this module the students can: | | | | | | |
| | - explain the methods of biological and biochemical research to determine the properties of biomolecules | | | | | | |
| | - name the basic components of a living organism | | | | | | |
| Knowledge | - explain the principles of metabolism | | | | | | |
| | - describe the structure of living cells | | | | | | |
| | - | | | | | | |
| | | | | | | | |
| Skills | | | | | | | |
| Personal Competence | | | | | | | |
| • | The students are able, | | | | | | |
| | - to gather knowledge in groups of about 10 stude | ents | | | | | |
| Social Competence | - to introduce their own knowledge and to argue their view in discussions in teams | | | | | | |
| | - to divide a complex task into subtasks, solve the | se and to present the com | bined result | ts | | | |
| Autonomy | The students are able to present the results of the | ir subtasks in a written rep | oort | | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lectur | e 84 | | | | | |
| Credit points | 6 | | | | | | |
| Studienleistung | None | | | | | | |
| | Written exam | | | | | | |
| Examination duration and scale | 90 min | | | | | | |
| | General Engineering Science (German program): General Engineering Science (German program, Compulsory Bioprocess Engineering: Core qualification: Comp General Engineering Science (English program): General Engineering Science (English program, Compulsory Technomathematics: Specialisation III. Engineerin | 7 semester): Specialisation pulsory Specialisation Bioproces: 7 semester): Specialisation | on Bioproce s Engineerir on Bioproce | ss Engineering: | | | |



| Course L0351: Biochem | istry | | | | |
|-----------------------|--|--|--|--|--|
| Тур | Lecture | | | | |
| Hrs/wk | | | | | |
| СР | | | | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | | | |
| Lecturer | Dr. Paul Bubenheim | | | | |
| Language | DE | | | | |
| Cycle | SoSe | | | | |
| Content | The molecular logic of Life Biomolecules: Amino acids, peptides, proteins Carbohydrates Lipids Protein functions, Enzymes: Michaelis-Menten kinetics Enzyme regulation Enzyme nomenclature Cofactors and cosubstrates, vitamines Metabolism: Basic principles Photosynthesis Glycolysis Citric acid cycle Respiration Anaerobic respirations Fatty acid metabolism Amino acid metabolism | | | | |
| Literature | Biochemie, H. Robert Horton, Laurence A. Moran, K. Gray Scrimeour, Marc D. Perry, J. David Rawn Pearson Studium, München Prinzipien der Biochemie, A. L. Lehninger, de Gruyter Verlag Berlin | | | | |



| Course L0728: Biochem | istry | | | | |
|-----------------------|--|--|--|--|--|
| Тур | Project-/problem-based Learning | | | | |
| Hrs/wk | | | | | |
| СР | | | | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | | | |
| Lecturer | Dr. Paul Bubenheim | | | | |
| Language | DE | | | | |
| Cycle | SoSe | | | | |
| Content | The molecular logic of Life Biomolecules: Amino acids, peptides, proteins Carbohydrates Lipids Protein functions, Enzymes: Michaelis-Menten kinetics Enzyme regulation Enzyme nomenclature Cofactors and cosubstrates, vitamines Metabolism: Basic principles Photosynthesis Glycolysis Citric acid cycle Respiration Anaerobic respirations Fatty acid metabolism Amino acid metabolism | | | | |
| Literature | Biochemie, H. Robert Horton, Laurence A. Moran, K. Gray Scrimeour, Marc D. Perry, J. David Rawn Pearson Studium, München Prinzipien der Biochemie, A. L. Lehninger, de Gruyter Verlag Berlin | | | | |
| | | | | | |



| Course L0881: Microbio | logy |
|------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Christian Schäfers |
| Language | DE |
| Cycle | SoSe |
| Content | 1. The procaryotic cell evolution taxonomy and specific properties of Archaea, Bacteria, and viruses structure and properties of the cell growth 2. Metabolism fermentation and anaerobic respiration methanogenesis and the anaerobic food chain degradation of polymers chemolithotrophy 3. Microorganisms in relation to the environment chemotaxis and motility Elemental cycle of carbon, nitrogen and sulfur biofilms symbiotic relationships extremophiles biotechnology |
| Literature | Allgemeine Mikrobiologie, 8. Aufl., 2007, Fuchs, G. (Hrsg.), Thieme Verlag (54,95 €) Mikrobiologie, 13 Aufl., 2013, Madigan, M., Martinko, J. M., Stahl, D. A., Clark, D. P. (Hrsg.), ehemals "Brock", Pearson Verlag (89,95 €) Taschenlehrbuch Biologie Mikrobiologie, 2008, Munk, K. (Hrsg.), Thieme Verlag Grundlagen der Mikrobiologie, 4. Aufl., 2010, Cypionka, H., Springer Verlag (29,95 €), http://www.grundlagen-der-mikrobiologie.icbm.de/ |



| Course L0888: Microbiol | ogy | | | | |
|-------------------------|--|--|--|--|--|
| Тур | Project-/problem-based Learning | | | | |
| Hrs/wk | | | | | |
| СР | 1 | | | | |
| Workload in Hours | dependent Study Time 16, Study Time in Lecture 14 | | | | |
| Lecturer | Dr. Christian Schäfers | | | | |
| Language | DE | | | | |
| Cycle | SoSe | | | | |
| Content | 1. The procaryotic cell evolution taxonomy and specific properties of Archaea, Bacteria, and viruses structure and properties of the cell growth 2. Metabolism fermentation and anaerobic respiration methanogenesis and the anaerobic food chain degradation of polymers chemolithotrophy 3. Microorganisms in relation to the environment chemotaxis and motility Elemental cycle of carbon, nitrogen and sulfur biofilms symbiotic relationships extremophiles biotechnology | | | | |
| Literature | Allgemeine Mikrobiologie, 8. Aufl., 2007, Fuchs, G. (Hrsg.), Thieme Verlag (54,95 €) Mikrobiologie, 13 Aufl., 2013, Madigan, M., Martinko, J. M., Stahl, D. A., Clark, D. P. (Hrsg.), ehemals "Brock", Pearson Verlag (89,95 €) Taschenlehrbuch Biologie Mikrobiologie, 2008, Munk, K. (Hrsg.), Thieme Verlag Grundlagen der Mikrobiologie, 4. Aufl., 2010, Cypionka, H., Springer Verlag (29,95 €), http://www.grundlagen-der-mikrobiologie.icbm.de/ | | | | |



| Courses | | | | | |
|--------------------------------|---|--|---|--|--|
| Γitle | | Тур | Hrs/wk | CP | |
| Signals and Systems (L043 | | Lecture | 3 | 4 | |
| Signals and Systems (L043 | 3) | Recitation Section (small) | 2 | 2 | |
| Module Responsible | Prof. Gerhard Bauch | | | | |
| Admission Requirements | None | | | | |
| | Mathematics 1-3 | | | | |
| | The modul is an introduction to the theor covered by the moduls Mathematik 1-3 is a (Fourier series, Fourier transform, Laplace to | expected. Further experience w | ith spectral | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | | |
| Professional | | | | | |
| Competence | | | | | |
| Knowledge | The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are able to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal. | | | | |
| Skills | The students are able to describe and analusing methods of signal and system theorimportant properties such as magnitude an the impact of LTI systems on the signal prop | y. They can analyse and desigd phase response, stability, line | n basic sys earity etc T | stems regardin | |
| Personal Competence | | | | | |
| Social Competence | The students can jointly solve specific probl | ems. | | | |
| Autonomy | The students are able to acquire relevant control their level of knowledge during the clicker system. | | | - | |
| Workload in Hours | Independent Study Time 110, Study Time in | Lecture 70 | | | |
| Credit points | 6 | | | | |
| Studienleistung | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and scale | 90 min | | | | |
| | General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German Engeneering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog | gram): Specialisation Computer gram): Specialisation Process E gram): Specialisation Bioproces on program): Specialisation on program): Specialisation on program): Specialisation Biomedical gram, 7 semester): Specialisation gram, 7 semester): Specialisation program, 7 s | Science: Congineering: s Engineering: s Engineering: Mechanical Engineering tion Electrical Sation Contation Proces | ompulsory Compulsory ng: Compulsor Enviromenta I Engineering ng: Compulsor al Engineering nputer Science | |



Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Mechatronics: Compulsory

Assignment for the

Following Curricula

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Theoretical Mechanical Engineering: Compulsory

Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



| Course L0432: Signals a | nd Systems | | | | | |
|-------------------------|--|--|--|--|--|--|
| Тур | Lecture | | | | | |
| Hrs/wk | 3 | | | | | |
| | CP 4 | | | | | |
| | Independent Study Time 78, Study Time in Lecture 42 | | | | | |
| | Prof. Gerhard Bauch | | | | | |
| Language Cycle | | | | | | |
| Content | Basic classification and description of continuous-time and discrete-time signals and systems Concvolution Power and energy of signals Correlation functions of deterministic signals Linear time-invariant (LTI) systems Signal transformations: Fourier-Series Fourier Transform Laplace Transform Discrete-time Fourier Transform Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT) Z-Transform Analysis and design of LTI systems in time and frequency domain Basic filter types Sampling, sampling theorem Fundamentals of recursive and non-recursive discrete-time filters | | | | | |
| Literature | T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004 K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag. B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997 J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002 S. Haykin, B. van Veen: Signals and systems. Wiley. Oppenheim, A.S. Willsky: Signals and Systems. Pearson. Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson. | | | | | |



| Course L0433: Signals and Systems | | |
|-----------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Gerhard Bauch | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0938: Bid | oprocess Engineer | ing - Fund | amental | s | | |
|--|--|--|----------------------------------|--|---|---------------------------------------|
| Courses | | | | | | |
| Title Bioprocess Engineering - Fundamentals (L0841) Bioprocess Engineering- Fundamentals (L0842) Bioprocess Engineering - Fundamental Practical Course (L0843) | | | | Fyp Lecture Recitation Section (large) Practical Course | Hrs/wk 2 2 2 | CP 3 1 2 |
| Module Responsible | 1 | (20010) | ' | Tabilda Godied | | |
| Admission Requirements | | | | | | |
| Recommended Previous Knowledge | none, module "organic ch | emistry", mod | ule "fundam | entals for process engi | neering" | |
| Educational Objectives | After taking part successfu | ully, students h | nave reache | d the following learning | results | |
| Professional | | | | | | |
| Competence | | | | | | |
| Knowledge | Students are able to desc different types of kinetics inhibition. The parameters in bioreactors can be e management, sterilization | for enzymes a s of stoichiome explained. The | nd microorgetry and rhe students | anisms, as well as to cology can be named ar are capable to expla | lifferentiate on and mass tran in fundame | lifferent types of sport processes |
| | After successful completion of this module, students should be able to describe different kinetic approaches for growth and substrate-uptake and to calculate the corresponding parameters predict qualitatively the influence of energy generation, regeneration of redox equivalents and growth inhibition on the fermentation process analyze bioprocesses on basis of stoichiometry and to set up / solve metabolic flux equations distinguish between scale-up criteria for different bioreactors and bioprocesses (anaerobic, aerobic as well as microaerobic) to compare them as well as to apply them to current biotechnical problem propose solutions to complicated biotechnological problems and to deduce the corresponding models to explore new knowledge resources and to apply the newly gained contents | | | | | |
| Skills | | | | | | ses (anaerobic, hem to current |
| Personal Competence | • to document and c | | | ustrial use and to formus well as results in a sc | | |
| reisonal Competence | | nodule partici | pants shou | d be able to debate t | echnical que | estions in small |
| Social Competence | After completion of this module participants should be able to debate technical questions in small teams to enhance the ability to take position to their own opinions and increase their capacity for teamwork in engineering and scientific environments. | | | | | |
| Autonomy | After completion of this module participants will be able to solve a technical problem in a team independently by organizing their workflow and to present their results in a plenum. | | | | | |
| Workload in Hours | Independent Study Time 9 | 96, Study Time | e in Lecture | 84 | | |
| Credit points | 6 | | | | | |
| | Compulsory Bonus | Form | | Description | | |
| Studienleistung | Yes None | Subject practical wor | theoretical rk | and | | |
| Examination | Written exam | | | | | |
| Examination duration and scale | 90 min | | | | | |
| | General Engineering Scie General Engineering Scie General Engineering Sci Compulsory | ence (German | program): S | pecialisation Bioproce | ss Engineeri | ng: Compulsory |



| | General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
|---------------------|---|
| | Bioprocess Engineering: Core qualification: Compulsory |
| | General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (English program): Specialisation Process Engineering: Compulsory |
| Assignment for the | General Engineering Science (English program, 7 semester): Specialisation Process Engineering: |
| Following Curricula | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: |
| | Compulsory |
| | Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Compulsory |
| | Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory |
| | Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory |
| | Biomedical Engineering: Specialisation Management and Business Administration: Elective |
| | Compulsory |
| | Technomathematics: Specialisation III. Engineering Science: Elective Compulsory |
| | Process Engineering: Core qualification: Compulsory |

| ourse L0841: Bioprocess Engineering - Fundamentals | | |
|--|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Andreas Liese, Prof. An-Ping Zeng | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Introduction: state-of-the-art and development trends in the biotechnology, introduction to the lecture Enzyme kinetics: Michaelis-Menten, differnt types of enzyme inhibition, linearization, conversion, yield, selectivity (Prof. Liese) Stoichiometry: coefficient of respiration, electron balance, degree of reduction, coefficient of yield, theoretical oxygen demand (Prof. Liese) Microbial growth kinetic: batch- and chemostat culture (Prof. Zeng) Kinetic of subtrate consumption and product formation (Prof. Zeng) Rheology: non-newtonian fluids, viscosity, agitators, energy input (Prof. Liese) Transport process in a bioreactor (Prof. Zeng) Technology of sterilization (Prof. Zeng) Fundamentals of bioprocess management: bioreactors and calculation of batch, fed-batch and continuouse bioprocesses (Prof. Zeng/Prof. Liese) Downstream technology in biotechnology: cell breakdown, zentrifugation, filtration, aqueous two phase systems (Prof. Liese) | |
| Literature | K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH, 2012 H. Chmiel: Bioprozeßtechnik, Elsevier, 2006 R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010 H.W. Blanch, D. Clark: Biochemical Engineering, Taylor & Francis, 1997 P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013 | |



| Course L0842: Bioprocess Engineering- Fundamentals | | |
|--|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | |
| Lecturer | Prof. Andreas Liese, Prof. An-Ping Zeng | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Introduction (Prof. Liese, Prof. Zeng) Enzymatic kinetics (Prof. Liese) Stoichiometry I + II (Prof. Liese) Microbial Kinetics I+II (Prof. Zeng) Rheology (Prof. Liese) Mass transfer in bioprocess (Prof. Zeng) Continuous culture (Chemostat) (Prof. Zeng) Sterilisation (Prof. Zeng) Downstream processing (Prof. Liese) Repetition (Reserve) (Prof. Liese, Prof. Zeng) | |
| Literature | siehe Vorlesung | |

| Course L0843: Bioprocess Engineering - Fundamental Practical Course | | | |
|---|--|--|--|
| Тур | Practical Course | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Andreas Liese, Prof. An-Ping Zeng | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | In this course fermentation and downstream technologies on the example of the production of an enzyme by means of a recombinant microorganism is learned. Detailed characterization and simulation of enzyme kinetics as well as application of the enzyme in a bioreactor is carried out. The students document their experiments and results in a protocol. | | |
| Literature | Skript | | |



| Courses | | | | |
|---|---|--|--|---|
| Title Heat and Mass Transfer (Li Heat and Mass Transfer (Li Heat and Mass Transfer (Li | 0102) | Typ Lecture Recitation Section (small) Recitation Section (large) | Hrs/wk 2 1 | CP 2 2 2 |
| Module Responsible | , , | necitation Section (large) | ı | 2 |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | | nics | | |
| Educational Objectives | After taking part successfully, students hav | re reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The students are capable of explair procedural apparatus (e. g. heat expressed in the procedural apparatus) (e. g. heat expressed in the procedural apparatus (e. g. heat expressed in the | schanger, chemical reactors). Ind characterize different kinds of ster and thermal radiation. Indicate the physical basis for many many many many many many many many | f heat trans ass transfer amass trans | fer mechanism in detail and to fer theories. |
| Skills | The students are able to set reason using the gained knowledge and respectively. They are capable to solve specific temperature alteration in fluids) and Using dimensionless quantities, the apparatus. They are able to distinguish between they can use this knowledge for column, rectification column). In this context, the students are can mass exchanger for a specific apprespectively. In addition, they can calculate both apparatus. The students are capable to connection of other courses (In particular the process engineering) to solve conditions. | d to balance the corresponding fic heat transfer problems (e.g. d to calculate the corresponding e students can execute scaling the period of the description and design of pable to choose and design fun plication considering their advance, steady-state and non-steady-state courses thermodynamics, fluid to course thermodynamics, fluid to course the course the course the course of the course o | heated che heat flows. up of technic ansition and apparatus damental ty ntages and ate process this course | emical reactors cal processes of d mass transfer (e.g. extraction pes of heat and disadvantages es in procedura |
| Personal Competence Social Competence | The students are capable to work recults orally in a reasonable many | | n teams an | d to present the |
| | The students are able to find and e They are able to prove their le procedure continuously (clicker-s) | vel of knowledge during the o | course with | accompanying |



| Autonomy | control their learning processes. | |
|---|--|--|
| | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | |
| Credit points | 5 | |
| Studienleistung | | |
| Examination | Written exam | |
| Examination duration and scale | 120 minutes; theoretical questions and calculations | |
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Core qualification: Compulsory | |



| Course L0101: Heat and Mass Transfer | | |
|--------------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Irina Smirnova | |
| Language | DE | |
| Cycle | WiSe | |
| Content | 1. Heat transfer Introduction, one-dimensional heat conduction Convective heat transfer Multidimensional heat conduction Non-steady heat conduction Thermal radiation 2. Mass transfer one-way diffusion, equimolar countercurrent diffusion boundary layer theory, non-steady mass transfer Heat and mass transfer single particle/ fixed bed Mass transfer and chemical reactions | |
| Literature | H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer VDI-Wärmeatlas | |

| Course L0102: Heat and Mass Transfer | |
|--------------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Irina Smirnova |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L1868: Heat and Mass Transfer | |
|--------------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Irina Smirnova |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | |
|-----------------------------------|--|---------------------------------|-------------|------------------|
| Title | | Тур | Hrs/wk | СР |
| Thermal Separation Process | ses (L0118) | Lecture | 2 | 2 |
| Thermal Separation Process | ses (L0119) | Recitation Section (small) | 2 | 2 |
| Thermal Separation Process | | Recitation Section (large) | 1 | 1 |
| Separation Processes (L115 | 59) | Practical Course | 1 | 1 |
| Module Responsible | Prof. Irina Smirnova | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Recommended requirements: Thermodynan | nics III | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The students can distinguish and describe different types of separation processes such a distillation, extraction, and adsorption The students develop an understanding for the course of concentration during a separation process, the estimation of the energy demand of a process, the possibilities of energy saving and the selection of separation systems They have good knowledge of designing methods for separation processes and devices | | | |
| Skills | Using the gained knowledge the students can select a reasonable system boundary for a give separation process and can close the associated energy and material balances The students can use different graphical methods for the designing of a separation proce and define the amount of theoretical stages required They can select and design a basic type of thermal separation process for a given case base on the advantages and disadvantages of the process The students are capable to obtain independently the needed material properties fro appropriate sources (diagrams and tables) They can calculate continuous and discontinuous processes The students are able to prove their theoretical knowledge in the experimental lab work. The students are able to discuss the theoretical background and the content of the experimental work with the teachers in colloquium. The students are capable of linking their gained knowledge with the content of other lectures and use it together for the solution of technical problems. Other lectures such as thermodynamics, flumechanics and chemical engineering. | | | |
| Personal Competence | The students can work technical a | ssignments in small groups a | and presen | t the combine |
| Social Competence | results in the tutorial | actical lab work in small group | s and orgar | nize a functiona |
| Autonomy | The students are capable to obtathemselves and assess their quality The students can proof the state of the this way control their learning process | neir knowledge with exam rese | | |



| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 | |
|---|---|--|
| Credit points | | |
| Studienleistung | | |
| Examination | | |
| Examination duration and scale | 120 minutes; theoretical questions and calculations | |
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory | |



| Course L0118: Thermal | Separation Processes | | |
|-----------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Irina Smirnova | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes | | |
| Literature | G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie | | |



| ourse L0119: Thermal | Separation Processes |
|----------------------|--|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Irina Smirnova |
| Language | DE |
| Cycle | WiSe |
| Content | Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes The students work on tasks in small groups and present their results in front of all students. |
| Literature | G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie |



| urse L0141: Thermal | Separation Processes |
|---------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Irina Smirnova |
| Language | DE |
| Cycle | WiSe |
| Content | Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes |
| Literature | G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed. McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie |



| Course L1159: Separation | on Processes | |
|--------------------------|---|--|
| Тур | Practical Course | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Irina Smirnova | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | The students work on eight different experiments in this practical course. For every one of the eight experiments, a colloquium takes place in which the students explain and discuss the theoretical background and its translation into practice with staff and fellow students. The students work small groups with a high degree of division of labor. For every experiment, the students write a report. They receive instructions in terms of scientific writing as well as feedback on their own reports and level of scientific writing so they can increase their capabilities in this area. Topics of the practical course: Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes | |
| Literature | G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry's Chemical Engineers' Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann's Enzyklopädie der Technischen Chemie | |



| Module M0892: Ch | nemical Reaction E | Engineerir | ng | | | |
|--|--|---|--|---|---|---|
| Courses | | | | | | |
| Title Chemical Reaction Engineer Chemical Reaction Engineer Experimental Course Chem | ring (Fundamentals) (L0244 |) | | Typ Lecture Recitation Section (large) Practical Course | Hrs/wk 2 2 2 | CP 2 2 2 |
| Module Responsible | Prof. Raimund Horn | | | | | |
| Admission Requirements | INANA | | | | | |
| | Contents of the previous as well as computational | | | I, physical chemistry, tec | chnical ther | modynamics I+II |
| Educational Objectives | After taking part success | sfully, students | s have reache | ed the following learning | results | |
| Professional Competence | | | | | | |
| Knowledge | The students are able t point out differences be ability to outline parts of | tween thermo | odynamical a | nd kinetical processes. | The student | s have a strong |
| | After successful complete | | | | th 1 : - | lo al voo atava |
| Skills | - apply different computer - determine and computer - | | | | somermanc | lear reactors, |
| | - conduct experiments guidelines. | on a lab-so | cale pilot pla | ants and document the | ese accordi | ng to scientific |
| Personal Competence | | | | | | |
| Social Competence | After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to solve issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and with their teachers. | | | | | |
| Autonomy | The students are able to can apply their knowlde | | | | | nously. Students |
| Workload in Hours | Independent Study Time | e 96, Study Tir | me in Lecture | 84 | | |
| Credit points | 6 | | | | | |
| Studienleistung | Compulsory Bonus | Form Subject | theoretical | Description and | | |
| | Yes None | practical w | ork | | | |
| Examination | Written exam | | | | | |
| Examination duration and scale | I 120 min | | | | | |
| _ | General Engineering So General Engineering So General Engineering So Compulsory General Engineering So Compulsory Bioprocess Engineering General Engineering So General Engineering So General Engineering So Compulsory General Engineering So | cience (Germa cience (Germa cience (Germa cience (Englis cience (Englis cience (Englis | an program): S nan program, 7 cation: Compi h program): S h program): S sh program, | Specialisation Bioproces 7 semester): Specialisation Ulsory Specialisation Bioproces Specialisation Process E 7 semester): Specialisation | as Engineeri ation Proce on Bioproce s Engineeri ngineering: ation Proce | ng: Compulsory ss Engineering: ss Engineering: ng: Compulsory Compulsory ss Engineering: |
| | Compulsory Process Engineering: C | | | | оп Бюргосе | ss Engineening: |

| Course L0204: Chemical Reaction Engineering (Fundamentals) | |
|--|--|
| Typ Lecture | |



| Hrs/wk | 2 |
|-------------------|---|
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Raimund Horn |
| Language | DE |
| Cycle | WiSe |
| | |

Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, massconcentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures)

Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, elementspecies-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)

Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)

Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhlernumber, differential and integral method of kinetic analysis, laboratory reactors for kinetic Content measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)

Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)

Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, molebalance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors)

non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)

lecture notes Raimund Horn

skript Frerich Keil

Books:



| M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Che | mie, |
|--|------|
| Wiley-VCH | |

- G. Emig, E. Klemm, Technische Chemie, Springer
- A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
- E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
- J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
- H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
- H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall Literature

O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998

- L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
- J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
- R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
- M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill
- G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010
- A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH

| Course L0244: Chemical Reaction Engineering (Fundamentals) | |
|--|--|
| Recitation Section (large) | |
| 2 | |
| 2 | |
| Independent Study Time 32, Study Time in Lecture 28 | |
| Prof. Raimund Horn, Dr. Oliver Korup | |
| DE | |
| WiSe | |
| | |

Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures)

Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)

Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)

Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate



Content

of change of species mole number, Arrhenius-equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integral method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)

Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)

Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, molebalance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors)

non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)

lecture notes Raimund Horn

skript Frerich Keil

Books:

M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH

G. Emig, E. Klemm, Technische Chemie, Springer

A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie

E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag

J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH

Literature

- H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
- H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall
- O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998
- L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
- J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
- R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
- M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill
- G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010
- A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH



| ourse L0221: Experime | ental Course Chemical Engineering (Fundamentals) |
|-----------------------|---|
| Тур | Practical Course |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Raimund Horn, Dr. Achim Bartsch |
| Language | DE/EN |
| Cycle | SoSe |
| Content | Performing and evaluation of experiments concerning chemical reaction engineering with emphasis on ideal reactors: * Batch reactor - Estimation of kinetic parameters for the saponification of ethylacetate * CSTR - Residence time distribution, reaction * CSTR in Series - Residence time distribution, reaction * Plug Flow Reactor - Residence time distribution, reaction Before the practical conduct of the experiments a colloquium takes place in which the students explain, reflect and discuss the theoretical basics and their translation into practice. The students write up a report for every experiment. They receive feedback to their level of scientific writing (citation methods, labeling of graphs, etc.), so that they can improve their competence in this field over the course of the practical course. |
| Literature | Levenspiel, O.: Chemical reaction engineering; John Wiley & Sons, New York, 3. Ed., 1999 VTM 309(LB) Praktikumsskript Skript Chemische Verfahrenstechnik 1 (F.Keil) |
| | |



| Module M0945: Bio | oprocess Engineering - Advance | ed | | | | |
|---|---|---|---------------|----------------|--|--|
| Courses | | | | | | |
| Title | | Тур | Hrs/wk | СР | | |
| Bioprocess Engineering - Ad Bioprocess Engineering - Ad | | Lecture Recitation Section (small) | 2 2 | 4 2 | | |
| Module Responsible | Prof. An-Ping Zeng | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous Knowledge | II Antent of module "Blochemical Engineering | ן נ" | | | | |
| _ | After taking part successfully, students have | reached the following learning | results | | | |
| Professional Competence | | | | | | |
| | After successful completion of this module, si | tudents should be able to | | | | |
| | describe and explain different kinetic | approaches for growth and sul | bstrate-upta | ke | | |
| Knowledge | identification of scientific problems v and mammalian cells) | vith concrete industrial use (cu | Iltivation of | microorganism | | |
| | describe and explain important down as basic immobilization methods | describe and explain important downstreaming steps for proteins and their application as well as basic immobilization methods | | | | |
| | After successful completion of this module, st | | | | | |
| | - to identifiy scientific questions or possible practical problems for concrete industrial applicat cultivation of microorganisms and animal cells) and to formulate solutions , | | | | | |
| | - To assess the application of scale-up crite apply these criteria to given problems (anaer | | - | rocesses and t | | |
| | - to formulate questions for the analysis processes appropriate solutions , | and optimization of real b | iotechnolog | ical productio | | |
| Skills | - To describe the effects of the energy generation, the regeneration of reduction equivalents, growth inhibition of the behavior of microorganisms and to the total fermentation process qualitative. | | | | | |
| - Establish material flow balance equations and solve them to determine the kinetic para different approaches and to calculate immobilization and activity yields, | | | | | | |
| | - to select process control strategies (batch , fed-batch , continuity) appropriately and to calcubasic types and evaluate them. | | | | | |
| Personal Competence | | | | | | |
| | After completion of this module participants should be able to debate technical questions in smeams to enhance the ability to take position to their own opinions and increase their capacity to | | | | | |
| Social Competence | teamwork. | | | | | |
| Autonomy | After completion of this module participants their knowledge to previously unknown issue | · · · · · · · · · · · · · · · · · · · | es of knowl | edge and appl | | |
| Workload in Hours | Independent Study Time 124, Study Time in | Lecture 56 | | | | |
| Credit points | | | | | | |
| Studienleistung | None | | | | | |



| | Written exam |
|---|--|
| Examination duration and scale | 90 min |
| Assignment for the Following Curricula | l General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory I |

| Course L1107: Bioproce | ess Engineering - Advanced | | | | |
|------------------------|---|--|--|--|--|
| Тур | Lecture | | | | |
| Hrs/wk | 2 | | | | |
| СР | 4 | | | | |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 | | | | |
| Lecturer | Prof. An-Ping Zeng, Prof. Andreas Liese, Dr. Wael Sabra | | | | |
| Language | DE | | | | |
| Cycle | WiSe | | | | |
| Content | Introduction: state-of-the-art and development trends of microbial and biocatalytic bioprocesses, introduction to the lecture Enzymatic process I: reactor types and criteria for industrial biotransformations (Prof. Liese) Enzymatic process II (Prof. Liese) Immobilization technologies: basic methods for isoltaed enzymes/ cells (Prof. Liese) Anaerobic fermentation processes (Prof. Zeng) Microaerobic bioprocesses: kinetics, energetics, optimal O2-supply and scale-up (Prof. Zeng) Fedbatch process and cultivation with high cell density (Prof. Zeng) Downstream processing of protein bioproduction: basics of chromatography, membrane filtration (Prof. Liese) Cell culture technology and continuous culture: basics, kinetics, media, reactors (Prof. Zeng) Problem-based learning with selected bioprocesses (Prof. Liese, Prof. Zeng) | | | | |
| Literature | K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH, 2012 H. Chmiel: Bioprozeßtechnik, Elsevier, 2006 R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010 H.W. Blanch, D. Clark: Biochemical Engineering, Taylor & Francis, 1997 P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013 Skripte für die Vorlesung | | | | |



| ourse L1108: Bioproce | ess Engineering - Advanced | | | | |
|-----------------------|---|--|--|--|--|
| Тур | Recitation Section (small) | | | | |
| Hrs/wk | 2 | | | | |
| СР | | | | | |
| Workload in Hours | dependent Study Time 32, Study Time in Lecture 28 | | | | |
| Lecturer | Prof. An-Ping Zeng, Prof. Andreas Liese | | | | |
| Language | DE | | | | |
| Cycle | WiSe | | | | |
| Content | Introduction: state-of-the-art and development trends of microbial and biocatalytic bioprocesses, introduction to the lecture Enzymatic process I: reactor types and criteria for industrial biotransformations (Prof. Liese) Enzymatic process II (Prof. Liese) Immobilization technologies: basic methods for isoltaed enzymes/ cells (Prof. Liese) Anaerobic fermentation processes (Prof. Zeng) Microaerobic bioprocesses: kinetics, energetics, optimal O2-supply and scale-up (Prof. Zeng) Fedbatch process and cultivation with high cell density (Prof. Zeng) Downstream processing of protein bioproduction: basics of chromatography, membrane filtration (Prof. Liese) Cell culture technology and continuous culture: basics, kinetics, media, reactors (Prof. Zeng) Problem-based learning with selected bioprocesses (Prof. Liese, Prof. Zeng) The students present exercises and discuss them with their fellow students and faculty statt. In the PBL part of the class the students discuss scientific questions in teams. They acquire knowledge and apply it to unknown questions, present their results and argue their opinions. | | | | |
| Literature | K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH, 2012 H. Chmiel: Bioprozeßtechnik, Elsevier, 2006 R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010 H.W. Blanch, D. Clark: Biochemical Engineering, Taylor & Francis, 1997 P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013 Skripte für die Vorlesung | | | | |



| Students can represent dyna particular explain properties o They can explain the dynam terms of frequency response a They can explain the Nyquists They can explain the role of the They can explain the way a response | Typ Lecture Recitation Section (small) Ins in time and frequency domain, Lapl Its have reached the following learning Its have reached the following learning | quency dom rpret dynam gins derived nesis of contr p in terms of | nain, and can i nic properties i from it. rol loops of its frequenc | |
|---|--|--|--|--|
| Herbert Werner eseentation of signals and system taking part successfully, students Students can represent dyna particular explain properties o They can explain the dynam terms of frequency response a They can explain the Nyquists They can explain the role of the They can explain the way a response They can explain issues aris | Recitation Section (small) Ins in time and frequency domain, Laple Its have reached the following learning Its have | lace transfor results quency dom rpret dynam gins derived lesis of contr | nain, and can in inic properties in from it. rol loops of its frequence | |
| esentation of signals and system taking part successfully, students Students can represent dyna particular explain properties o They can explain the dynam terms of frequency response a They can explain the Nyquists They can explain the role of the They can explain the way a response They can explain issues aris | ts have reached the following learning amic system behavior in time and free of first and second order systems nics of simple control loops and interestand root locus stability criterion and the stability marghe phase margin in analysis and synthal PID controller affects a control loops. | quency dom rpret dynam gins derived nesis of contr p in terms of | nain, and can i nic properties i from it. rol loops of its frequenc | |
| esentation of signals and system taking part successfully, students Students can represent dyna particular explain properties o They can explain the dynam terms of frequency response a They can explain the Nyquists They can explain the role of the They can explain the way a response They can explain issues aris | ts have reached the following learning amic system behavior in time and free of first and second order systems nics of simple control loops and interestand root locus stability criterion and the stability marghe phase margin in analysis and synthal PID controller affects a control loops. | quency dom rpret dynam gins derived nesis of contr p in terms of | nain, and can i nic properties i from it. rol loops of its frequenc | |
| Students can represent dyna particular explain properties o They can explain the dynam terms of frequency response a They can explain the Nyquists They can explain the role of the They can explain the way a response They can explain issues aris | ts have reached the following learning amic system behavior in time and free of first and second order systems nics of simple control loops and interestand root locus stability criterion and the stability marghe phase margin in analysis and synthal PID controller affects a control loops. | quency dom rpret dynam gins derived nesis of contr p in terms of | nain, and can i nic properties i from it. rol loops of its frequenc | |
| Students can represent dyna particular explain properties o They can explain the dynam terms of frequency response a They can explain the Nyquists They can explain the role of the They can explain the way a response They can explain issues aris | amic system behavior in time and free of first and second order systems nics of simple control loops and inter and root locus stability criterion and the stability marg he phase margin in analysis and synth a PID controller affects a control loop | quency dom rpret dynam gins derived nesis of contr p in terms o | nic properties i from it. rol loops of its frequenc | |
| particular explain properties of They can explain the dynam terms of frequency response at They can explain the Nyquists. They can explain the role of the They can explain the way a response. They can explain issues arise | of first and second order systems nics of simple control loops and interand root locus stability criterion and the stability marghe phase margin in analysis and synthal PID controller affects a control loop | rpret dynam gins derived nesis of contr p in terms o | nic properties i from it. rol loops of its frequenc | |
| particular explain properties of They can explain the dynam terms of frequency response at They can explain the Nyquists. They can explain the role of the They can explain the way a response. They can explain issues arise | of first and second order systems nics of simple control loops and interand root locus stability criterion and the stability marghe phase margin in analysis and synthal PID controller affects a control loop | rpret dynam gins derived nesis of contr p in terms o | nic properties i from it. rol loops of its frequenc | |
| | | | | |
| Students can transform models of linear dynamic systems from time to frequency domain an vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus an frequency response techniques They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks | | | | |
| | | | | |
| | to jointly solve technical problems, a | and experim | nentally validat | |
| their controller designs Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress. | | | | |
| oendent Study Time 124. Study 1 | Time in Lecture 56 | | | |
| | | | | |
| 9 | | | | |
| | | | | |
| | | | | |
| | vice versa They can simulate and asses They can design PID controlle They can analyze and syn frequency response techniqu They can calculate discrete- and use it for digital implement They can use standard softwat tasks They can use it when the controller designs The controlle | vice versa They can simulate and assess the behavior of systems and control They can design PID controllers with the help of heuristic (Ziegler-N They can analyze and synthesize simple control loops with the frequency response techniques They can calculate discrete-time approximations of controllers do and use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simitasks) Jents can work in small groups to jointly solve technical problems, and controller designs Jents can obtain information from provided sources (Jecture notes teriment guides) and use it when solving given problems. Y can assess their knowledge in weekly on-line tests and thereby controller exam Jents the provided sources in the provided sources and the problems. Y can assess their knowledge in weekly on-line tests and the proposition of the provided sources. | vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tunin They can analyze and synthesize simple control loops with the help of frequency response techniques They can calculate discrete-time approximations of controllers designed in and use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for catasks Jents can work in small groups to jointly solve technical problems, and experiment controller designs Jents can obtain information from provided sources (Jecture notes, software teriment guides) and use it when solving given problems. Y can assess their knowledge in weekly on-line tests and thereby control their learn pendent Study Time 124, Study Time in Lecture 56 | |



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

General Engineering Science (English program): Core qualification: Compulsory

Assignment for the General Englowing Curricula Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory



Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective

Compulsory

Process Engineering: Core qualification: Compulsory

| - | I a strong | | | | |
|------------|---|--|--|--|--|
| | Lecture | | | | |
| Hrs/wk | | | | | |
| CP | | | | | |
| | dependent Study Time 92, Study Time in Lecture 28 | | | | |
| | of. Herbert Werner | | | | |
| Language | | | | | |
| Cycle | Signals and systems | | | | |
| | Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability | | | | |
| | Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle | | | | |
| | Root locus techniques Root locus plots Root locus design of PID controllers | | | | |
| Content | Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Time delay systems | | | | |
| | Root locus and frequency response of time delay systems Smith predictor Digital control | | | | |
| | Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers | | | | |
| | Software tools | | | | |
| | Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course | | | | |
| Literature | Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic System Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, 2010 | | | | |



| Course L0655: Introduction to Control Systems | | | |
|---|--|--|--|
| Тур | citation Section (small) | | |
| Hrs/wk | 2 | | |
| СР | | | |
| Workload in Hours | endent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Herbert Werner | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |



| Courses | | | | | | |
|--|--|--|--|--|---|--|
| Title | | | Тур | Hrs/wk | СР | |
| Practical Exercise Environmental Technology (L1387) Environmental Technologie (L0326) | | | Practical Course Lecture | 1 2 | 1 2 | |
| Module Responsible | Dr. Joachim Gerth | | | | | |
| Admission Requirements | None | | | | | |
| Previous Knowledge | | Fundamentals of inorganic/organic chemistry and biology | | | | |
| - | After taking part successfu | ully, students have reach | ed the following lear | ning results | | |
| Professional Competence | | this modul the stude | nts obtain profoun | d knowledge of | environment | |
| Knowledge | technology. They are abl give an overview of scien methods. | | | | | |
| Skills | problems. They are abl pollutants to migrate and Environmental Technolog | Students are able to propose appropriate management and mitigation measures for environmental problems. They are able to determine geochemical parameters and to assess the potential conclusants to migrate and transform. The students are able to work out well founded opinions on how the contributes to sustainable development, and they can present and defendable opinions in front of and against the group. | | | | |
| Personal Competence | | | | | | |
| Social Competence | The students are able to discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They are able to develop different approaches to the task as a group as well as to discuss their theoretical or practical implementation. | | | | | |
| Autonomy | Students can independer tranfer it to new problems | Students can independently exploit sources about of the subject, acquire the particular knowledge an tranfer it to new problems. | | | | |
| Workload in Hours | Independent Study Time | 48, Study Time in Lecture | 42 | | | |
| Credit points | 3 | | | | | |
| Studienleistung | Yes None | Form Subject theoretical practical work | Description and | 1 | | |
| | Written exam | | | | | |
| Examination duration and scale | I 1 hour | | | | | |
| | General Engineering Standard Engineering: Compulsory General Engineering Standard Engineering: Energy and Environments | cience (German progra Science (German prog g: Compulsory ence (German program, ence (German program, | m): Specialisation ram, 7 semester) , 7 semester): Special re Compulsory | Process Engine : Specialisation ialisation Proces isation Bioproce | eering: Electiv n Energy ar ss Engineerin | |



General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Elective Compulsory
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Elective Compulsory
Process Engineering: Core qualification: Elective Compulsory

| Course L1387: Practical | Exercise Environmental Technology |
|-------------------------|--|
| Тур | Practical Course |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Joachim Gerth |
| Language | DE |
| Cycle | SoSe |
| Content | The experiment demonstrates the effect of ionic strength on the binding of dissolved zinc and phosphate by soil surfaces. From the results it can be inferred that the potential of soil surfaces is modified by the application of salt. This has consequences for the retention of nutrients and pollutants. The experiment is carried out with iron oxide rich soil material. Within the lab course students discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or practical implementation. |
| Literature | F. Scheffer und P. Schachtschabel (2002): "Lehrbuch der Bodenkunde" TUB Signatur AGG-308 W.E.H. Blum (2007): "Bodenkunde in Stichworten" TUB Signatur AGG-317 C. A. J. Appelo; D. Postma (2005): "Geochemistry, groundwater and pollution" TUB Signatur GWC-515 |

| Course L0326: Environn | nental Technologie | | | |
|------------------------|---|--|--|--|
| Тур | Lecture | | | |
| Hrs/wk | | | | |
| СР | 2 | | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | | |
| Lecturer | Dr. Joachim Gerth, Prof. Martin Kaltschmitt, Prof. Kerstin Kuchta | | | |
| Language | DE | | | |
| Cycle | WiSe | | | |
| Content | Introductory seminar on environmental science: Environmental impact and adverse effects Wastewater technology Air pollution control Noise protection Waste and recycling management Soil and ground water protection Renewable energies Resource conservation and energy efficiency | | | |
| Literature | Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972-5 (ISBN) | | | |



| Courses | | | | | | |
|--|---|---|---------------------------|-------------|----------------|--|
| | | | _ | | | |
| Title Process and Plant Engineer | ing I (I 0005) | | Typ Lecture | Hrs/wk 2 | CP 2 | |
| Process and Plant Engineer | - ' | | Recitation Section (large | | 2 | |
| Process and Plant Engineering I (L1014) | | | Recitation Section (small | | 2 | |
| Module Responsible | Prof. Georg Fieg | | | | | |
| Admission Requirements | None | | | | | |
| • | unit operation of therma | I an dmechanical separation | on processes | | | |
| Recommended Previous Knowledge | chemical reactor eingine | eering | | | | |
| Educational Objectives | After taking part success | sfully, students have reach | ed the following learnir | ng results | | |
| Professional Competence | | | | | | |
| | students can: | | | | | |
| | classify and formulate bl | lobal balance equations of | f chemical processes | | | |
| | specify linear componer | nt equations of complex ch | emical processes | | | |
| Knowledge | | | | | | |
| | explain linear regression and data reconcilliation problems | | | | | |
| | explain pfd-diagrams | | | | | |
| | students are capable of | | | | | |
| | - formulation of mass and energy balance equations and estimation of product streams | | | | | |
| | - estimation of component streams of chemical plants using linear component balance models | | | | | |
| Skills | - solution of data reconc | illiation tasks | | | | |
| | - conduction of process synthesis | | | | | |
| | - economic evaluation o | economic evaluation of processes and the estimation of production costs | | | | |
| Personal Competence | | | | | | |
| Social Competence | | | | | | |
| Autonomy | | | | | | |
| Workload in Hours | Independent Study Time | e 124, Study Time in Lectu | re 56 | | | |
| Credit points | 6 | | | | | |
| | Compulsory Bonus | Form | Description | | | |
| Studienleistung | Yes 10 % | Subject theoretical practical work | and | | | |
| Evamination | Written exam | practical work | | | | |
| Examination duration | | and books | | | | |
| and scale | Gonoral Engineering Co | nionoo (Gorman program): | Specialization Process | Enginocrina | Compulsor | |
| | General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulso General Engineering Science (German program, 7 semester): Specialisation Process Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy ar Environmental Engineering: Elective Compulsory | | | | | |
| Assignment for the Following Curricula Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compuls | | | | | | |



General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Elective Compulsory

Process Engineering: Core qualification: Compulsory

| Тур | Lecture |
|----------|--|
| Hrs/wk | 2 |
| СР | |
| | Independent Study Time 32, Study Time in Lecture 28 |
| | Prof. Georg Fieg |
| Language | |
| Conten | 1. Introduction Structure and operation of production plants Operational business process Technical process design Motivation and targets of process development Life cycle of production plants 2. Engineering methods and tools Mass and energy balances Strategies of process synthesis Graphical representation of processes Multidimensional regression Data reconciliation and data validation 3. Process Synthesis Decision levels Experimental process development Reactor synthesis Synthesis of separation processes (process alternatives and criteria for selection) Integration of reaction systems/separation systems (interactions, recycle streams) 4. Process safety 5. Cost estimation of production plants Production costs, capital costs, economic evaluation |
| | S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679 |
| | H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74 |
| | Behr, W. Ebbers, N. Wiese, ChemIngTech. 72(2000)Nr. 10, S.1157 |
| | E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997 |
| | M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916 |
| | R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte, |
| | Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&Co.KGaA, Weinheim, 2004 |
| | J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988 |
| | G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19 |
| | G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306 |
| | G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213 |
| | G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133 |



| | U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlung Blazek und Bergamann, Frankfurt, 2000 |
|------------|--|
| Literature | J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991 |
| Literature | T.F. Edgar, D.M. Himmelblau, L.S. Lasdon, Optimization of Chemical Processes, McGraw-Hill, 2001 |
| | G. Gruhn, Vorlesungsmanuskript "Prozess- und Anlagentechnik, TU Hamburg-Harburg |
| | D. Hairston, Chemical Engineering, October 2001, S. 31-37 |
| | J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2002 |
| | J. Krekel, G. Siekmann, ChemIngTech. 57(1985)Nr. 6, S. 511 |
| | K. Machej, G. Fieg, J. Wojcik, Inz. Chem. Proc., 2(1981), S.815-824 |
| | S. Meier, G. Kaibel, ChemIngTech. 62(1990)Nr. 13, S.169 |
| | J. Mittelstraß, ChemIngTech. 66(1994), S. 309 |
| | P. Li, M. Flender, K. Löwe, G. Wozny, G. Fieg, Fett/Lipid 100(1998), Nr. 12, S. 528-534 |

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G. Kaibel, Dissertation, TU München, 1987

G. Kaibel, Chem.-Ing.-Tech. 61 (1989), Nr. 2, S. 104-112

G. Kaibel, Chem. Eng. Technol., 10(1987), Nr. 2, S. 92-98

H.J. Lang, Chem. Eng. 54(10),117, 1947

H.J. Lang, Chem. Eng. 55(6), 112, 1948

F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76

| ourse L0096: Process and Plant Engineering I | | |
|--|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Georg Fieg | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L1214: Process and Plant Engineering I | | |
|---|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Georg Fieg | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | | |
|-----------------------------------|-----------------------------------|--|---------------------------------|-----------------|----------------|
| Title | | | Тур | Hrs/wk | СР |
| Particle Technology I (L0434 | t) | | Lecture | 2 | 3 |
| Particle Technology I (L0435 | | | Recitation Section (small) | 1 | 1 |
| Particle Technology I (L0440 | • | | Practical Course | 2 | 2 |
| Module Responsible | Prof. Stefan Heinrich | | | | |
| Requirements | None | | | | |
| Recommended Previous Knowledge | keine | | | | |
| Educational Objectives | After taking part succes | ssfully, students have reac | hed the following learning | results | |
| Professional | | | | | |
| Competence | After augenment | etion of the module studer | to are able to | | |
| Knowledge | name and expl | ain processes and unit-oparticles, particle distribution | perations of solids process | | |
| Skills | solids propertie asses solids wi | esign apparatuses and pro es of the product ith respect to their behavio work scientifically. | • | | to the desire |
| Personal Competence | | | | | |
| Social Compelence | | to discuss scientific topics echnical-scientific issues in | | or scientific p | ersonal and t |
| Autonomy | Students are able to ar | nalyze and solve questions | s regarding solid particles | ndependent | y. |
| Workload in Hours | Independent Study Tin | me 110, Study Time in Lect | ure 70 | | |
| Credit points | 6 | | | | |
| | Compulsory Bonus | Form | Description | | |
| Studienleistung | Yes None | Written elaboration | sechs Berichte (5-10 Seiten | pro Versuch | ein Bericht) a |
| Examination | Written exam | | | | |
| | 90 minutes | | | | |
| and scale | | Science (German program) | : Specialisation Process E | ngineering: (| Compulsory |



General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory
Process Engineering: Core qualification: Compulsory

| Course L0434: Particle | Technology I |
|------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Stefan Heinrich |
| Language | DE |
| Cycle | SoSe |
| Content | Description of particles and particle distributions Description of a separation process Description of a particle mixture Particle size reduction Agglomeration, particle size enlargement Storage and flow of bulk solids Basics of fluid/particle flows classifying processes Separation of particles from fluids Basic fluid mechanics of fluidized beds Pneumatic and hydraulic transport |
| Literature | Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992. |

| Course L0435: Particle Technology I | | |
|-------------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Stefan Heinrich | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Course L0440: Particle | Technology I |
|------------------------|---|
| Тур | Practical Course |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Stefan Heinrich |
| Language | DE/EN |
| Cycle | SoSe |
| Content | Sieving Bulk properties Size reduction Mixing Gas cyclone Blaine-test, filtration Sedimentation |
| Literature | Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992. |



| M. J.J. Macaa | | | | | |
|---|--|------------------------------------|---------|--------|--|
| Module M0829: Fo | undations of Management | | | | |
| Courses | | | | | |
| Title | 2) | Typ | Hrs/wk | CP | |
| Management Tutorial (L0882 Introduction to Management | | Recitation Section (large) Lecture | 2 3 | 3 3 | |
| Module Responsible | Prof. Christoph Ihl | | | | |
| Admission Requirements | INONA | | | | |
| Recommended Previous Knowledge | Basic Knowledge of Mathematics and Business | 5 | | | |
| Educational Objectives | After taking part successfully, students have rea | ached the following learning | results | | |
| Professional Competence | | | | | |
| | After taking this module, students know the important basics of many different areas in Busi Management, from Planning and Organisation to Marketing and Innovation, and also to Ir and Controlling. In particular they are able to • explain the differences between Economics and Management and the sub-disc | | | | |
| Knowledge | Management and to name important definitions from the field of Management explain the most important aspects of and goals in Management and name the most important aspects of entrepresental projects. | | | | |
| Skills | Students are able to analyse business units with respect to different criteria (organization, objective strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to • analyse Management goals and structure them appropriately • analyse organisational and staff structures of companies • apply methods for decision making under multiple objectives, under uncertainty and under ris • analyse production and procurement systems and Business information systems • analyse and apply basic methods of marketing • select and apply basic methods from mathematical finance to predefined problems • apply basic methods from accounting, costing and controlling to predefined problems | | | | |
| Personal Competence | | | | | |
| Social Competence | Students are able to work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a cohere report on the project to communicate appropriately and to cooperate respectfully with their fellow students. | | | | |
| Autonomy | Students are able to work in a team and to organize the team to write a report on their project. | n themselves | | | |
| | Independent Study Time 110, Study Time in Le | cture 70 | | | |
| Credit points | | | | | |
| Studienleistung | | | | | |
| | Subject theoretical and practical work | | | | |
| Examination duration | | | | | |



and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

Assignment for the Following Curricula

Compulsory

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:



Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

| Course L0882: Managen | nent Tutorial |
|-----------------------|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Christoph Ihl, Katharina Roedelius, Tobias Vlcek |
| Language | DE |
| Cycle | WiSe/SoSe |
| Content | In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools. If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on self-selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the business knowledge from the lecture should come to practical use. The group projects are guided by a mentor. |
| Literature | Relevante Literatur aus der korrespondierenden Vorlesung. |



| rse Lubbu: Introduct | ion to Management | | | |
|----------------------|---|--|--|--|
| | Lecture | | | |
| Hrs/wk | 3 | | | |
| СР | 3 | | | |
| Workload in Hours | lependent Study Time 48, Study Time in Lecture 42 | | | |
| Lecturer | Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona | | | |
| Language | DE | | | |
| Cycle | WiSe/SoSe | | | |
| Content | Introduction to Business and Management, Business versus Economics, relevant areas i Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects | | | |
| Literature | Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgar 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006. | | | |



| Courses | | | | |
|--|---|---|--|--|
| Title | (1,0000) | Тур | Hrs/wk | CP |
| Environmental Assessment Environmental Assessment | | Lecture Recitation Section (small) | 2 1 | 2 1 |
| Module Responsible | Prof. Martin Kaltschmitt | | | |
| Admission Requirements | None | | | |
| Recommended | Fundamentals of inorganic/organic chemistry and biology | | | |
| Previous Knowledge | After taking part successfully, students have | reached the following learning | a results | |
| Professional | Alter taking part successiony, students have | e reached the following learning | g resuits | |
| Competence | | | | |
| Knowledge | With the completion of this module the students acquire in-depth knowledge of important cause-effect chains of potential environmental problems which might occur from production processes, projects of construction measures. They have knowledge about the methodological diversity and are competent in dealing with different methods and instruments to assess environmental impacts. Besides the students are able to estimate the complexity of these environmental processes as well as uncertainties and difficulties with their measurement. | | | |
| Skills | The students are able to select a suitable method for the respective case from the variety of assessment methods. Thereby they can develop suitable solutions for managing and mitigating environmental problems in a business context. They are able to carry out Life Cycle Impact Assessments independently and can apply the software programs OpenLCA and the database Ecolnvent. After finishing the course the students have the competence to critically judge research results or other publications on environmental impacts. | | | |
| Personal Competence | | | | |
| Social Competence | The students are able to discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They are able to develop jointly different solutions and to discuss their theoretical or practical implementation. Due to the selected lecture topics, the students receive insights into the multi-layered issues of the environment protection and the concept of sustainability. Their sensitivity | | | |
| Autonomy | The students learn to research, process ar carry out independent scientific work. They and are able to judge results of other public | can solve an environmental p | | |
| Workload in Hours | Independent Study Time 48, Study Time in | Lecture 42 | | |
| Credit points | - | | | |
| Studienleistung | | | | |
| | Written exam | | | |
| Examination duration and scale | 1 hour written exam | | | |
| | General Engineering Science (German Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German Environmental Engineering: Compulsory General Engineering Science (German pro Elective Compulsory General Engineering Science (German pro Elective Compulsory | program): Specialisation Pron n program, 7 semester): S rogram, 7 semester): Speciali | ocess Engine Specialisation sation Proce | eering: Electiv n Energy an ss Engineerinç |



| Assignment for the | Energy and Environmental Engineering: Core qualification: Compulsory |
|---------------------|--|
| Following Curricula | General Engineering Science (English program): Specialisation Energy and Environmental |
| | Engineering: Compulsory |
| | General Engineering Science (English program): Specialisation Process Engineering: Elective |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental |
| | Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Process Engineering: |
| | Elective Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: |
| | Elective Compulsory |
| | Process Engineering: Core qualification: Elective Compulsory |
| | Process Engineering: Core qualification: Compulsory |

| Course L0860: Environm | nental Assessment |
|------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Anne Rödl, Dr. Christoph Hagen Balzer |
| Language | DE/EN |
| Cycle | SoSe |
| | Contaminants: Impact- and Risk Assessment |
| | Environmental damage & precautionary principle: Environmental Risk Assessment (ERA) |
| | Resource and water consumption: Material flow analysis |
| | Energy consumption: Cumulated energy demand (CED), cost analysis |
| Content | Life cycle concept: Life cycle assessment (LCA) |
| | Sustainability: Comprehensive product system assessment, SEE-Balance |
| | Management: Environmental and Sustainability management (EMAS) |
| | Complex systems: MCDA and scenario method |
| | |
| | Foliensätze der Vorlesung |
| Literature | Studie: Instrumente zur Nachhaltigkeitsbewertung - Eine Synopse (Forschungszentrum Jülich GmbH) |
| | |



| Course L1054: Environn | nental Assessment |
|------------------------|--|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Martin Kaltschmitt |
| Language | DE |
| Cycle | SoSe |
| Content | Presentation and application of free software programs in order to understand the concepts of environmental assessment methods better. Within the group exercise students discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or practical implementation. |
| Literature | Power point Präsentationen |



Specialization Electrical Engineering

The educational objective of the General Engineering Science BSc program's electrical engineering specialization is to develop the ability to choose and combine fundamental methods and processes in order to solve technical tasks in engineering science and, especially, the specialization subject.

Graduates will have

- 1) A firm grounding in mathematics, physics, electrical engineering, and computer science
- 2) A basic knowledge of systems theory, control systems, and electrical power and energy or measurement technology
- 3) In-depth knowledge of engineering science areas, especially their specialization area (electrical engineering materials and components, semiconductor technology, communications engineering, electromagnetig theory). They will, in particular, have the methodological skills required for applying their knowledge to the solution of technical problems, taking technical, economic and societal requirements into account.

| Courses | | | | |
|--|---|-------------------------|------------------|----------------|
| Title Circuit Theory (L0566) Circuit Theory (L0567) | Typ Lectu Recit | | Hrs/wk 3 2 | CP 4 2 |
| Module Responsible | | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Electrical Engineering I and II, Mathematics I and II | | | |
| Educational Objectives | After taking part successfully, students have reached the | ne following learning r | results | |
| Professional Competence Knowledge | | | | |
| Skills | The students are able to calculate currents and voltages in linear networks by means of basic methods, also when driven by periodic signals. They are able to calculate transients in electrical circuits in time and frequency domain and are able to explain the respective transient behaviour. They are able to analyse and to synthesize the frequency behaviour of passive two-terminal-circuits. | | | |
| Personal Competence | | | | |
| Social Competence | Students work on exercise tasks in small guided groups their results within the group. | os. They are encouraç | ged to prese | ent and discus |
| Autonomy | The students are able to find out the required methods for solving the given practice problems Possibilities are given to test their knowledge during the lectures continuously by means of short-time tests. This allows them to control independently their educational objectives. They can link their gained knowledge to other courses like Electrical Engineering I and Mathematics I. | | | |
| | | | | |



| Workload in Hours Credit points | Independent Study Time 110, Study Time in Lecture 70 |
|------------------------------------|--|
| Studienleistung | None |
| Examination | Written exam |
| Examination duration and scale | 1 130 Mili |
| | General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory |

| Course L0566: Circuit The | t a un a |
|---------------------------|--|
| | |
| Typ L | _ecture |
| Hrs/wk 3 | 3 |
| CP 4 | 1 |
| Workload in Hours | ndependent Study Time 78, Study Time in Lecture 42 |
| Lecturer F | Prof. Arne Jacob |
| Language | DE |
| Cycle V | <i>N</i> iSe |
| - | · Circuit theorems |
| - | N-port circuits |
| - | Periodic excitation of linear circuits |
| Content - | Transient analysis in time domain |
| - | Transient analysis in frequency domain; Laplace Transform |
| - | Frequency behaviour of passive one-ports |
| - | M. Albach, "Grundlagen der Elektrotechnik 1", Pearson Studium (2011) |
| - | M. Albach, "Grundlagen der Elektrotechnik 2", Pearson Studium (2011) |
| - | L. P. Schmidt, G. Schaller, S. Martius, "Grundlagen der Elektrotechnik 3", Pearson Studium (2011) |
| | T. Harriehausen, D. Schwarzenau, "Moeller Grundlagen der Elektrotechnik", Springer (2013) |
| | A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2008) R. C. Dorf, J. A. Svoboda, "Introduction to electrical circuits", Wiley (2006) |
| | L. Moura, I. Darwazeh, "Introduction to Linear Circuit Analysis and Modeling", Amsterdam Newnes (2005) |
| | |



| Course L0567: Circuit Theory | | |
|------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Arne Jacob | |
| Language | DE | |
| Cycle | WiSe | |
| Content | see interlocking course | |
| | siehe korrespondierende Lehrveranstaltung | |
| Literature | see interlocking course | |



| Module M0730: Co | omputer Engineeri | ing | | | |
|---|---|----------------------------|---------------------------------------|---------------|------------------|
| Courses | | | | | |
| Title | | | Тур | Hrs/wk | СР |
| Computer Engineering (L0321) Computer Engineering (L0324) | | | Lecture Recitation Section (small) | 3 1 | 4 2 |
| Module Responsible | Prof. Heiko Falk | | | | |
| Admission Requirements | INone | | | | |
| Recommended Previous Knowledge | Basic knowledge in electrical engineering The successful completion of the labs will be honored during the evaluation of the module's examination according to the following rules: 1. Upon a passed module examination, the student is granted a bonus on the examination's marks due to the successful labs, such that the examination's marks are lifted by 0,3 or 0,4, respectively, up to the next-better grade. 2. The improvement of the grade 5,0 up to 4,3 and of 4,3 up to 4,0 is not possible. | | | | |
| Educational Objectives | After taking part success | sfully, students have reac | hed the following learning | g results | |
| Professional Competence | | | | | |
| Knowledge | This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-level programming down to gates. The module includes the following topics: • Introduction • Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks • Sequential logic: Flip-flops, automata, systematic hardware design • Technological foundations • Computer arithmetic: Integer addition, subtraction, multiplication and division • Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining • Memories: Memory hierarchies, SRAM, DRAM, caches • Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses The students perceive computer systems from the architect's perspective, i.e., they identify the internal | | | | |
| Skills | structure and the physical composition of computer systems. The students can analyze, how highl specific and individual computers can be built based on a collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers of today computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencie between a physical computer system and the software executed on it. In particular, they sha understand the consequences that the execution of software has on the hardware-centric abstractio layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to proposite easible options. | | | | |
| Personal Competence | ; | | | | |
| Social Competence | Students are able to sol | ve similar problems alone | e or in a group and to pres | sent the resu | its accordingly. |
| Autonomy | Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. | | | | |
| Workload in Hours | Independent Study Time | e 124, Study Time in Lect | ure 56 | | |
| Credit points | 6 | | | | |
| Studienleistung | Compulsory Bonus Yes 10 % | Form Excercises | Description | | |
| Examination | Written exam | | | | |



| General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory |
|---|
| Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory |
| General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory |
| General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory |
| Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aitcraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory |
| Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory |
| Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering. |
| General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory |
| General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory |
| General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| |
| 11 ocus i toduci Developineni and i toducijon. Compulsory |
| General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| Focus Energy Systems: Compulsory Computer Science: Core qualification: Compulsory |
| Electrical Engineering: Core qualification: Compulsory |
| Assignment for the Following Curricula General Engineering Science (English program): Core qualification: Compulsory Following Curricula General Engineering Science (English program, 7 semester): Specialisation Computer Science: |
| Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: |
| Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: |
| Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: |
| Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: |
| Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| Focus Product Development and Production: Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory |



Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory

| Course L0321: Computer Engineering | | | |
|------------------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 3 | | |
| СР | | | |
| Workload in Hours | lependent Study Time 78, Study Time in Lecture 42 | | |
| Lecturer | Prof. Heiko Falk | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output | | |
| Literature | A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. | | |

| Course L0324: Computer Engineering | | |
|------------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| | eoretical Electrical Engineering | | | |
|-----------------------------------|--|--|--|--|
| Courses | | | | |
| Title | | Тур | Hrs/wk | CP |
| | ering I: Time-Independent Fields (L0180) ering I: Time-Independent Fields (L0181) | Lecture Recitation Section (sr | 3 mall) 2 | 5 1 |
| Module Responsible | Prof. Christian Schuster | | | |
| Admission | None | | | |
| Requirements | Barta de de la constanta de la | and and the second consideration of the second considerati | | |
| Recommended Previous Knowledge | Basic principles of electrical engineering a | no advanced mathematics | | |
| Educational Objectives | After taking part successfully, students have | e reached the following lea | rning results | |
| Professional Competence | | | | |
| Knowledge | Students can explain the fundamental findependent electromagnetic fields. The magnetostatic, and current density fields properties of complex electromagnetic field. The students are aware of applications for are able to explicate these. | y can explicate the prin with regard to respective a ds by means of superpositi | cipal behavior sources. They can of solutions for the can be solutions for the can be solutions for the case of th | of electrostation an describe the or simple field: |
| Skills | Students can apply Maxwell's Equations in integral notation in order to solve highly symmetrical, time-independent, electromagnetic field problems. Furthermore, they are capable of applying a variety of methods that require solving Maxwell's Equations for more general problems. The students can assess the principal effects of given time-independent sources of fields and analyze these quantitatively. They can deduce meaningful quantities for the characterization of electrostatic magnetostatic, and electrical flow fields (capacitances, inductances, resistances, etc.) from given fields and dimension them for practical applications. | | | |
| Personal Competence | | | | |
| • | Students are able to work together on sub | ject related tasks in small (| groups. They are | able to preser |
| Social Competence | their results effectively (e.g. during exercise | e sessions). | | |
| Autonomy | Students are capable to gather necessary information from provided references and relate thi information to the lecture. They are able to continually reflect their knowledge by means of activitie that accompany the lecture, such as short oral quizzes during the lectures and exercises that are related to the exam. Based on respective feedback, students are expected to adjust their individual learning process. They are able to draw connections between their knowledge obtained in this lecture and the content of other lectures (e.g. Electrical Engineering I, Linear Algebra, and Analysis). | | | |
| Workload in Hours | Independent Study Time 110, Study Time in | n Lecture 70 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 90-150 minutes | | | |
| Assignment for the | General Engineering Science (German pro General Engineering Science (German pro Compulsory Electrical Engineering: Core qualification: General Engineering Science (English pro | ogram, 7 semester): Speci Compulsory | alisation Electric | al Engineering |



| Following Curricula | General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: |
|---------------------|---|
| | Compulsory |
| | Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective |
| | Compulsory |
| | Technomathematics: Specialisation III. Engineering Science: Elective Compulsory |

| Tvn | Lecture | | |
|-------------------|---|--|--|
| Hrs/wk | | | |
| СР | | | |
| Vorkload in Hours | Independent Study Time 108, Study Time in Lecture 42 | | |
| | Prof. Christian Schuster | | |
| Language | DE | | |
| Cycle | SoSe | | |
| | - Maxwell's Equations in integral and differential notation | | |
| | - Boundary conditions | | |
| | - Laws of conservation for energy and charge | | |
| | - Classification of electromagnetic field properties | | |
| | - Integral characteristics of time-independent fields (R, L, C) | | |
| Content | - Generic approaches to solving Poisson's Equation | | |
| | - Electrostatic fields and specific methods of solving | | |
| | - Magnetostatic fields and specific methods of solving | | |
| | - Fields of electrical current density and specific methods of solving | | |
| | - Action of force within time-independent fields | | |
| | - Numerical methods for solving time-independent problems | | |
| | | | |
| | - G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010) | | |
| | - H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011) | | |
| Literature | - W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011) | | |
| | - D. Griffiths, "Introduction to Electrodynamics", Pearson (2012) | | |
| | - J. Edminister, " Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013) | | |
| | | | |
| | - Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011) | | |



| | cal Electrical Engineering I: Time-Independent Fields | | |
|-------------------|---|--|--|
| | Recitation Section (small) | | |
| Hrs/wk | | | |
| СР | | | |
| | Independent Study Time 2, Study Time in Lecture 28 | | |
| | Prof. Christian Schuster | | |
| Language Cycle | | | |
| Сусіе | - Maxwell's Equations in integral and differential notation | | |
| Content | - Boundary conditions - Laws of conservation for energy and charge | | |
| | - Classification of electromagnetic field properties | | |
| | Integral characteristics of time-independent fields (R, L, C) Generic approaches to solving Poisson's Equation | | |
| | - Electrostatic fields and specific methods of solving | | |
| | - Magnetostatic fields and specific methods of solving | | |
| | - Fields of electrical current density and specific methods of solving | | |
| | - Action of force within time-independent fields | | |
| | - Numerical methods for solving time-independent problems | | |
| | - G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010) | | |
| Literature | - H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011) | | |
| | - W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011) | | |
| | - D. Griffiths, "Introduction to Electrodynamics", Pearson (2012) | | |
| | - J. Edminister, " Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013) | | |
| | - Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011) | | |
| | | | |



| Courses | | | | |
|-----------------------------------|---|--|--|--|
| Title | | Тур | Hrs/wk | СР |
| Signals and Systems (L043) | | Lecture | 3 | 4 |
| Signals and Systems (L043) | 3) | Recitation Section (small) | 2 | 2 |
| Module Responsible | Prof. Gerhard Bauch | | | |
| Admission Requirements | None | | | |
| | Mathematics 1-3 | | | |
| | The modul is an introduction to the theo covered by the moduls Mathematik 1-3 is (Fourier series, Fourier transform, Laplace | expected. Further experience w | ith spectral | - |
| Educational Objectives | After taking part successfully, students have | e reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are able to apply the fundamental transformations continuous-time and discrete-time signals and systems. They can describe and analyse determinist signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal. | | | |
| Skills | The students are able to describe and ana using methods of signal and system theorem important properties such as magnitude ar the impact of LTI systems on the signal properties. | ry. They can analyse and designd phase response, stability, line | n basic sys earity etc T | stems regardin |
| Personal Competence | | | | |
| Social Competence | The students can jointly solve specific prob | lems. | | |
| Autonomy | The students are able to acquire relevant control their level of knowledge during the clicker system. | | | - |
| Workload in Hours | Independent Study Time 110, Study Time in | n Lecture 70 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 90 min | | | |
| | General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (Germa Engeneering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German pro General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory | gram): Specialisation Computer gram): Specialisation Process E gram): Specialisation Bioproces in program): Specialisation in program): Specialisation gram): Specialisation Biomedical gram, 7 semester): Specialisation program, 7 semester): Specialisation gram, 7 semester): Spec | Science: Congineering: s Engineering: s Engineering: s Engineering: Mechanical Engineering: sation Electrical Electrical Engineering: sation Congation Processon Bioprocesson Bioprocesson | ompulsory Compulsory ng: Compulsor I Enviromenta I Engineering ng: Compulsor cal Engineering nputer Science ss Engineering |



Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

Assignment for the

Following Curricula

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Theoretical Mechanical Engineering: Compulsory

Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

Computational Science and Engineering: Core qualification: Compulsory

Computational Science and Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



| Course L0432: Signals a | nd Systems | | |
|-------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 3 | | |
| СР | | | |
| | Independent Study Time 78, Study Time in Lecture 42 | | |
| | Prof. Gerhard Bauch | | |
| Language Cycle | | | |
| Content | Basic classification and description of continuous-time and discrete-time signals and systems Concvolution Power and energy of signals Correlation functions of deterministic signals Linear time-invariant (LTI) systems Signal transformations: Fourier-Series Fourier Transform Laplace Transform Discrete-time Fourier Transform Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT) Z-Transform Analysis and design of LTI systems in time and frequency domain Basic filter types Sampling, sampling theorem Fundamentals of recursive and non-recursive discrete-time filters | | |
| Literature | T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004 K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag. B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997 J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002 S. Haykin, B. van Veen: Signals and systems. Wiley. Oppenheim, A.S. Willsky: Signals and Systems. Pearson. Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson. | | |



| Course L0433: Signals and Systems | |
|-----------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Gerhard Bauch |
| Language | DE/EN |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M0748: Ma | aterials in Electrical Engineering | | | |
|--|---|---|---------------|-------------------|
| Wodule Wo7 40. Wa | iterials in Electrical Engineering | | | |
| Courses | | | | |
| Courses | | _ | | |
| Title | 4 | Тур | Hrs/wk | CP |
| Electrotechnical Experiment | | Lecture | 1 | 1 |
| Materials in Electrical Engine | eering (Lu685) eering (Problem Solving Course) (L0687) | Lecture Recitation Section (small) | 2 | 3 2 |
| | 1 | riecitation dection (smail) | | |
| Module Responsible | Prof. Manfred Eich | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Highschool level physics and mathematics | | | |
| Educational Objectives | After taking part successfully, students have rea | ched the following learning | results | |
| Professional | - | <u> </u> | | |
| Competence | | | | |
| Knowledge | Students can explain the composition and the engineering. Students can explicate the relemagnetic and chemical properties of materials in | evance of mechanical, ele | ectrical, the | rmal, dielectric, |
| Skills | Students can identify appropriate descriptive me approximative solutions and judge factors inflengineering applications. | | - | • |
| Personal Competence Social Competence | Students can jointly solve subject related problems in groups. They can present their results effectively within the framework of the problem solving course. | | | |
| Autonomy | Students are capable to extract relevant information from the provided references and to relate this information to the content of the lecture. They can reflect their acquired level of expertise with the help of lecture accompanying measures such as exam typical exam questions. Students are able to connect their knowledge with that acquired from other lectures. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Led | ture 70 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| | Written exam | | | |
| Examination duration and scale | 60 minutes | | | |
| | General Engineering Science (German program General Engineering Science (German progra Compulsory Electrical Engineering: Core qualification: Comp General Engineering Science (English program General Engineering Science (English program Compulsory | m, 7 semester): Specialisa oulsory): Specialisation Electrical E | tion Electric | al Engineering: |

Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory



| Course L0714: Electrotechnical Experiments | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 1 | |
| СР | 1 | |
| | Independent Study Time 16, Study Time in Lecture 14 | |
| | Dr. Wieland Hingst | |
| Language | | |
| Cycle | | |
| Content | Agenda: - Natural sources of electricity - Oscilloscope - Characterizing signals - 2 terminal circuit elements - 2-ports - Power - Matching - Inductive coupling - Resonance - Radio frequencies | |
| | - Transistor circuits - Electrical measurement - Materials for the EE - Electrical fun | |
| Literature | Tietze, Schenk: "Halbleiterschaltungstechnik", Springer | |



| Course L0685: Materials | s in Electrical Engineering | | |
|-------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Manfred Eich | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | The Hamiltonian approach to classical mechanics. Analysis of a simple oscillator. Analysis of vibrations in a one-dimensional lattice. Phononic bandgap Introduction to quantum mechanics Wave function, Schrödinger's equation, observables and measurements. Quantum mechanical harmonic oscillator and spectral decomposition. Symmetries, conserved quantities, and the labeling of states. Angular momentum The hydrogen atom Waves in periodic potentials Reciprocal lattice and reciprocal lattice vectors Band gap Band diagrams The free electron gas and the density of states Fermi-Dirac distribution Density of charge carriers in semiconductors Conductivity in semiconductors. Engineering conductivity through doping. The P-N junction (diode) Light emitting diodes Electromagnetic waves interacting with materials Reflection and refraction Photonic band gaps Origins of magnetization Hysteresis in ferromagnetic materials Magnetic domains | | |
| Literature | 1.Anikeeva, Beach, Holten-Andersen, Fink, Electronic, Optical and Magnetic Properties of Materials, Massachusetts Institute of Technology (MIT), 2013 2.Hagelstein et al., Introductory Applied Quantum and Statistical Mechanics, Wiley 2004 3.Griffiths, Introduction to Quantum Mechanics, Prentice Hall, 1994 4.Shankar, Principles of Quantum Mechanics, 2nd ed., Plenum Press, 1994 5.Fick, Einführung in die Grundlagen der Quantentheorie, Akad. Verlagsges., 1979 6.Kittel, Introduction to Solid State Physics, 8th ed., Wiley, 2004 7.Ashcroft, Mermin, Solid State Physics, Harcourt, 1976 8.Pierret, Semiconductor Fundamentals Vol. 1, Addison Wesley, 1988 9.Sze, Physics of Semiconductor Devices, Wiley, 1981 10.Saleh, Teich, Fundamentals of Photonics, 2nd ed., 2007 11.Joannopoulos, Johnson, Winn Meade, Photonic Crystals, 2nd ed., Princeton Universty Press, 2008 12.Handley, Modern Magnetic Materials, Wiley, 2000 13.Wikipedia, Wikimedia | | |



| Course L0687: Materials in Electrical Engineering (Problem Solving Course) | | |
|--|--|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Manfred Eich | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Atom structure and periodic system Atom binding and crystal structure Structure and properties of alloys: diffusion, phase diagrams, phase separation and grain boundaries Material properties: Mechanical, thermal, electrical, dielectric properties Metals Semiconductors Ceramics and glasses Polymers Magnetic materials Electrochemistry Oxidation numbers, electrolysis, batteries, fuel cells | |
| Literature | H. Schaumburg: Einführung in die Werkstoffe der Elektrotechnik, Teubner (1993) | |



| Courses | | | | | |
|--|--|--|--|------------------------|-----------------------------|
| Title | | | Тур | Hrs/wk | СР |
| | Il Engineering, Computer Science, | | Seminar | 2 | 2 |
| Transmission Line Theory (L0570) | | Lecture | 2 | 3 | |
| Transmission Line Theory (| | | Recitation Section (large) | 2 | 1 |
| Module Responsible | Prof. Arne Jacob | | | | |
| Admission Requirements | None | | | | |
| <u>-</u> | Electrical Engineering I-III, Ma | athematics I-III | | | |
| | After taking part successfully, | students have reache | ed the following learning | results | |
| Professional | | | | | |
| Competence | | | | | |
| Knowledge | Students can explain the fun frequencies. They are able to They can describe simple ec with coupled transmission line | o analyze circuits with quivalent circuits of tr | n transmission lines in ti ansmission lines. They | me and frecare able to | quency doma solve proble |
| Skills | Students can analyze and colines. They are able to analyze equivalent circuits of transmission lines using the professionals. | lyze circuits in frequification frequification frequience. | ency domain and with They are able to solve p | the Smith o | hart. They cluding coupl |
| Personal Competence Social Competence | Students can analyze and s compare the learned theory able to present a research top | with experiments in t | he lecture and discuss i | | • |
| Autonomy | The students can solve problems by their own and are able to acquire skills from the lecture and the literature. They are able to test their knowledge using computer animations. They can test their level knowledge by answering short questions and tests during the lecture. They are able to relate the acquired knowledge to other lectures (e.g. Electrical Engineering I-III and Mathematics I-III). They can familiarize themselves with a research topic and can prepare a presentation. | | | | |
| Workload in Hours | Independent Study Time 96, S | Study Time in Lecture | 84 | | |
| Credit points | 6 | | | | |
| O | ' ' | orm | Description | | |
| Studienleistung | I YAS NODA | ubject theoretical actical work | and | | |
| Fyamination | Written exam | | | | |
| Examination duration and scale | | | | | |
| Assignment for the Following Curricula | General Engineering Science General Engineering Science Compulsory Electrical Engineering: Core of General Engineering Science | e (German program, qualification: Compuls e (English program): S | 7 semester): Specialisa sory Specialisation Electrical E | tion Electric | al Engineerir Compulsory |



Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory

| Course L0571: Research Seminar Electrical Engineering, Computer Science, Mathematics | | |
|--|---|--|
| Тур | Seminar | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Dozenten des SD E | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | Seminar talk on a given subject | |
| Literature | Themenabhängig / subject related | |

| Course L0570: Transmission Line Theory | | |
|--|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Arne Jacob | |
| Language | DE | |
| Cycle | SoSe | |
| Content | - Wave propagation along transmission lines - Transient behavior of transmission lines - Transmission lines in steady state - Impedance transformation and Smith chart - Equivalent circuits - Coupled transmission lines and symmetrical components | |
| Literature | - Unger, HG., "Elektromagnetische Wellen auf Leitungen", Hüthig Verlag (1991) | |

| Course L0572: Transmission Line Theory | |
|--|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Prof. Arne Jacob |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M0854: Ma | athematics IV | | | |
|-----------------------------------|--|---|-------------|------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| . , | tial Differential Equations) (L1043) | Lecture | 2 | 1 |
| | tial Differential Equations) (L1044) | Recitation Section (small) | 1 | 1 |
| Complex Functions (L1038) | tial Differential Equations) (L1045) | Recitation Section (large) Lecture | 1 | 1 |
| Complex Functions (L1041) | | Recitation Section (small) | 1 | 1 |
| Complex Functions (L1042) | | Recitation Section (large) | 1 | 1 |
| Module Responsible | | · · · · · · · · · · · · · · · · · · · | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | I Mathematice 1 - III | | | |
| Educational Objectives | After taking part successfully, students hav | re reached the following learning | results | |
| Professional | | | | |
| Competence | | | | |
| Knowledge | Students can name the basic conceappropriate examples. Students can discuss logical conillustrating these connections with the They know proof strategies and care | nections between these conce the help of examples. | | _ |
| Skills | Students can model problems in Mathematics IV with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods. Students are able to discover and verify further logical connections between the concepts studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results. | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to work togeth common language. In doing so, they can communicate partners. Moreover, they can desig peers. | e new concepts according to the | needs of th | neir cooperating |
| Autonomy | Students are capable of checking to can specify open questions precise Students have developed sufficient oriented manner on hard problems | ely and know where to get help in t persistence to be able to work f | solving the | m. |
| Workload in Hours | Independent Study Time 68, Study Time in | Lecture 112 | | |
| Credit points | 6 | | | |
| Studienleistung | | | | |
| | Written exam | | | |
| Examination duration | | | | |
| and scale | 160 min (Complex Functions) + 60 min (Diff | erential Equations 2) | | |
| | I | | | |



General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus

General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory

Assignment for the Following Curricula

Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus

Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Specialisation Mechatronics: Compulsory

Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory



| Course L1043: Differential Equations 2 (Partial Differential Equations) | | |
|---|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Main features of the theory and numerical treatment of partial differential equations Examples of partial differential equations First order quasilinear differential equations Normal forms of second order differential equations Harmonic functions and maximum principle Maximum principle for the heat equation Wave equation Liouville's formula Special functions Difference methods Finite elements | |
| Literature | http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html | |

| Course L1044: Differential Equations 2 (Partial Differential Equations) | |
|---|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L1045: Differential Equations 2 (Partial Differential Equations) | |
|---|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Course L1038: Complex Functions | | |
|---------------------------------|--|--|
| Тур | ecture | |
| Hrs/wk | 2 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Main features of complex analysis Functions of one complex variable Complex differentiation Conformal mappings Complex integration Cauchy's integral theorem Cauchy's integral formula Taylor and Laurent series expansion Singularities and residuals Integral transformations: Fourier and Laplace transformation | |
| Literature | http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html | |

| Course L1041: Complex Functions | |
|---------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L1042: Complex Functions | |
|---------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M0675: Int | roduction to Communications and F | Random Processes | 5 | |
|--|--|--|--|--|
| Courses | | | | |
| | ions and Random Processes (L0442) ions and Random Processes (L0443) | Typ Lecture Recitation Section (large) | Hrs/wk 3 1 | CP 4 2 |
| Module Responsible | Prof. Gerhard Bauch | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Mathematics 1-3 Signals and Systems Basic knowledge of probability theory | | | |
| Educational Objectives | After taking part successfully, students have reach | ned the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The students know and understand the fundamental building blocks of a communications system. They can describe and analyse the individual building blocks using knowledge of signal and system theory as well as the theory of stochastic processes. The are aware of the essential resources an evaluation criteria of information transmission and are able to design and evaluate a basi communications system. | | nal and system resources and | |
| Skills | The students are able to design and evaluate a basic communications system. In particular, they can estimate the required resources in terms of bandwidth and power. They are able to assess essential evaluation parameters of a basic communications system such as bandwidth efficiency or bit error rate and to decide for a suitable transmission method. | | | |
| Personal Competence Social Competence | The students can is inthe calve appeific problems | | | |
| Autonomy | The students are able to acquire relevant information from appropriate literature sources. They car control their level of knowledge during the lecture period by solving tutorial problems, software tools clicker system. | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 90 min | | | |
| | General Engineering Science (German program) General Engineering Science (German program Compulsory Computer Science: Specialisation Computer and Electrical Engineering: Core qualification: Computer General Engineering Science (English program): General Engineering Science (English program Compulsory Computational Science and Engineering: Special Computational Science and Engineering: Core qualification: Elective of Technomathematics: Core qualification: Electi | Software Engineering: Electrical Engineering: Electrical Engineering: Electrical Engineering: Specialisation Engineering Scient Lisation Engineering Scient Lisation: Compulsorying Science: Elective Compus | tion Electricated in Electricated Engineering: tion Electricated in Electricat | al Engineering: ulsory Compulsory al Engineering: |



| Course L0442: Introduct | tion to Communications and Random Processes | | |
|--|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | Hrs/wk 3 | | |
| СР | 4 | | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | | |
| | Prof. Gerhard Bauch | | |
| Language | | | |
| Cycle | <u>WiSe</u> | | |
| Content | Fundamentals of random processes Introduction to communications engineering Quadrature amplitude modulation Description of radio frequency transmission in the equivalent complex baseband Transmission channels, channel models Analog digital conversion: Sampling, quantization, pulsecode modulation (PCM) Fundamentals of information theory, source coding, channel coding Digital baseband transmission: Pulse shaping, eye diagramm, 1. and 2. Nyquist condition, matched filter, detection, error probability Fundamentals of digital modulation | | |
| K. Kammeyer: Nachrichtenübertragung, Teubner P.A. Höher: Grundlagen der digitalen Informationsübertragung, Teubner. M. Bossert: Einführung in die Nachrichtentechnik, Oldenbourg. J.G. Proakis, M. Salehi: Grundlagen der Kommunikationstechnik. Pearson Studium. J.G. Proakis, M. Salehi: Digital Communications. McGraw-Hill. S. Haykin: Communication Systems. Wiley Literature J.G. Proakis, M. Salehi: Communication Systems Engineering. Prentice-Hall. J.G. Proakis, M. Salehi, G. Bauch, Contemporary Communication Systems. Cengage Learning. | | | |

| Course L0443: Introduction to Communications and Random Processes | |
|---|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Gerhard Bauch |
| Language | DE/EN |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | |
|-----------------------------------|--|--|--|--|
| | eering II: Time-Dependent Fields (L0182) | Typ Lecture | Hrs/wk | CP 5 |
| Theoretical Electrical Engine | ering II: Time-Dependent Fields (L0183) | Recitation Section (sr | nall) 2 | 1 |
| Module Responsible | Prof. Christian Schuster | | | |
| Admission Requirements | None | | | |
| | Electrical Engineering I, Electrical Engineering | ng II, Theoretical Electrical | I Engineering I | |
| Recommended Previous Knowledge | Mathematics I, Mathematics II, Mathematics I | II, Mathematics IV | | |
| Educational Objectives | After taking part successfully, students have | reached the following lear | ning results | |
| Professional Competence | | | | |
| Knowledge | Students are able to explain fundamental formulas, relations, and methods related to the theory of time-dependent electromagnetic fields. They can assess the principal behavior and characteristics of quasistationary and fully dynamic fields with regard to respective sources. They can describe the properties of complex electromagnetic fields by means of superposition of solutions for simple fields. The students are aware of applications for the theory of time-dependent electromagnetic fields and are able to explicate these. | | | |
| Skills | Students are able to apply a variety of procedures in order to solve the diffusion and the wave equation for general time-dependent field problems. They can assess the principal effects of given time-dependent sources of fields and analyze these quantitatively. They can deduce meaningful quantities for the characterization of fully dynamic fields (wave impedance, skin depth, Poynting-vector, radiation resistance, etc.) from given fields and interpret them with regard to practical applications. | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to work together on subjetheir results effectively (e.g. during exercise s | _ | groups. They a | re able to presen |
| Autonomy | Students are capable to gather necessary information to the lecture. They are able to that accompany the lecture, such as short related to the exam. Based on respective for learning process. They are able to draw or research at the Hamburg University of Telegineering and optics. | continually reflect their known oral quizzes during the eedback, students are exconnections between accommendations. | nowledge by madestures and expected to adjusting the pected to adjusting the modest and the contract of the pected by the contract of the pected by the pect | neans of activities exercises that are st their individua dge and ongoing |
| Workload in Hours | Independent Study Time 110, Study Time in | Lecture 70 | | |
| Credit points | <u> </u> | | | |
| Studienleistung | | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 90-150 minutes | | | |
| | General Engineering Science (German prog General Engineering Science (German pro Compulsory | | _ | |



Assignment for the | Electrical Engineering: Core qualification: Compulsory

Following Curricula General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Technomathematics: Core qualification: Elective Compulsory

| Course L0182: Theoretical Electrical Engineering II: Time-Dependent Fields | | |
|--|---|--|
| Тур | Lecture | |
| Hrs/wk | | |
| СР | | |
| | Independent Study Time 108, Study Time in Lecture 42 | |
| | Prof. Christian Schuster | |
| Language Cycle | | |
| - Oyele | - Theory and principal characteristics of quasistationary electromagnetic fields | |
| | - Electromagnetic induction and law of induction | |
| | - Skin effect and eddy currents | |
| | - Shielding of time variable magnetic fields | |
| | - Theory and principal characteristics of fully dynamic electromagnetic fields | |
| | - Wave equations and properties of planar waves | |
| Content | - Polarization and superposition of planar waves | |
| | - Reflection and refraction of planar waves at boundary surfaces | |
| | - Waveguide theory | |
| | - Rectangular waveguide, planar optical waveguide | |
| | - Elektrical and magnetical dipol radiation | |
| | - Simple arrays of antennas | |
| | | |
| | - G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010) | |
| | - H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011) | |
| | - W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011) | |
| Literature | - D. Griffiths, "Introduction to Electrodynamics", Pearson (2012) | |
| | - J. Edminister, "Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013) | |
| | - Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011) | |
| | | |



| Course L0183: Theoretical Electrical Engineering II: Time-Dependent Fields | | |
|--|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | |
| | Prof. Christian Schuster | |
| Language | | |
| Cycle | | |
| | - Theory and principal characteristics of quasistationary electromagnetic fields | |
| | - Electromagnetic induction and law of induction | |
| | - Skin effect and eddy currents | |
| | - Shielding of time variable magnetic fields | |
| | - Theory and principal characteristics of fully dynamic electromagnetic fields | |
| | - Wave equations and properties of planar waves | |
| Content | - Polarization and superposition of planar waves | |
| | - Reflection and refraction of planar waves at boundary surfaces | |
| | - Waveguide theory | |
| | - Rectangular waveguide, planar optical waveguide | |
| | - Elektrical and magnetical dipol radiation | |
| | - Simple arrays of antennas | |
| | | |
| | - G. Lehner, "Elektromagnetische Feldtheorie: Für Ingenieure und Physiker", Springer (2010) | |
| | - H. Henke, "Elektromagnetische Felder: Theorie und Anwendung", Springer (2011) | |
| | - W. Nolting, "Grundkurs Theoretische Physik 3: Elektrodynamik", Springer (2011) | |
| Literature | - D. Griffiths, "Introduction to Electrodynamics", Pearson (2012) | |
| | - J. Edminister, "Schaum's Outline of Electromagnetics", Mcgraw-Hill (2013) | |
| | - Richard Feynman, "Feynman Lectures on Physics: Volume 2", Basic Books (2011) | |
| | | |



| Module M1235: Ele | ectrical Power Systems I | | | |
|---|--|--------------------------------|---------|----|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Electrical Power Systems I | | Lecture | 3 | 4 |
| Electrical Power Systems I | (L1671) | Recitation Section (large) | 2 | 2 |
| | Prof. Christian Becker | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Fundamentals of Electrical Engineering | | | |
| Educational Objectives | After taking part successfully, students have i | reached the following learning | results | |
| Professional | | | | |
| Competence | | | | |
| Knowledge | Students are able to give an overview of conventional and modern electric power systems. They car explain in detail and critically evaluate technologies of electric power generation, transmission storage, and distribution as well as integration of equipment into electric power systems. | | | |
| Skills | With completion of this module the students are able to apply the acquired skills in applications of the design, integration, development of electric power systems and to assess the results. | | | |
| Personal Competence | | | | |
| Social Competence | The students can participate in specialized and interdisciplinary discussions, advance ideas and represent their own work results in front of others. | | | |
| Autonomy | Students can independently tap knowledge of the emphasis of the lectures. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in | Lecture 70 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 90 - 150 minutes | | | |
| Assignment for the Following Curricula | | | | |



| Course L1670: Electrical Power Systems I | | |
|--|---|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| СР | 4 | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | |
| Lecturer | Prof. Christian Becker | |
| Language | DE | |
| Cycle | WiSe | |
| Content | fundamentals and current development trends in electric power engineering tasks and history of electric power systems symmetric three-phase systems fundamentals and modelling of eletric power systems ines transformers synchronous machines induction machines loads and compensation grid structures and substations fundamentals of energy conversion electro-mechanical energy conversion thermodynamics power station technology renewable energy conversion systems steady-state network calculation enetwork modelling load flow calculation enetwork modelling load flow calculations, short-circuit power control in networks and power stations grid protection grid planning power economy fundamentals K Heuck K -D Dettmann D Schulz: "Flektrische Energieversorgung", Vieweg + Teubner 9 Auflage | |
| Literature | K. Heuck, KD. Dettmann, D. Schulz: "Elektrische Energieversorgung", Vieweg + Teubner, 9. Auflage, 2013 A. J. Schwab: "Elektroenergiesysteme", Springer, 5. Auflage, 2017 R. Flosdorff: "Elektrische Energieverteilung" Vieweg + Teubner, 9. Auflage, 2008 | |
| | | |



| Course L1671: Electrica | I Power Systems I | | |
|-------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Christian Becker | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | fundamentals and current development trends in electric power engineering tasks and history of electric power systems symmetric three-phase systems fundamentals and modelling of eletric power systems ines transformers synchronous machines induction machines loads and compensation grid structures and substations fundamentals of energy conversion electro-mechanical energy conversion thermodynamics power station technology renewable energy conversion systems steady-state network calculation network modelling load flow calculation enetwork modelling load flow calculations, short-circuit power control in networks and power stations grid protection grid planning power economy fundamentals K Heuck K-D Dattmann D Schulz: "Flektrische Energieversorgung". Vieweg + Teubner 9 Auflage | | |
| Literature | K. Heuck, KD. Dettmann, D. Schulz: "Elektrische Energieversorgung", Vieweg + Teubner, 9. Auflage, 2013 A. J. Schwab: "Elektroenergiesysteme", Springer, 5. Auflage, 2017 R. Flosdorff: "Elektrische Energieverteilung" Vieweg + Teubner, 9. Auflage, 2008 | | |
| | | | |



| Module M0760: Ele | ectronic Devices | | | | |
|---|---|---|--|---|--|
| Courses | | | | | |
| Title Electronic Devices (L0720) Electronic Devices (L0721) | | Typ Hrs/wk CP Lecture 3 4 Project-/problem-based Learning 2 2 | | | |
| Module Responsible | Prof. Hoc Khiem Trieu | | 5 | | |
| Admission Requirements | | | | | |
| Recommended Previous Knowledge | Atomic model and quant physics Successful participation of with equivalent contents | | | | |
| Educational Objectives | After taking part successfu | ılly, students have reache | ed the following learning | results | |
| Professional Competence | | | | | |
| Knowledge | Students are able to represent the basics of semiconductor physics, to explain the operating principle of important semiconductor devices, to outline device characteristics and equivalent circuits as well as to explain their derivation and to discuss the limitation of device models. | | | their derivation | |
| Skills | | | complex problems by one | eself | |
| Personal Competence | | | | | |
| - | Students are able to prepare and perform their lab experiments in team work as well as to present and discuss the results in front of audience. | | | | |
| Autonomy | Students are capable to acquire knowledge based on literature in order to prepare their experiments. | | | | |
| Workload in Hours | Independent Study Time 1 | 110, Study Time in Lectui | re 70 | | |
| Credit points | 6 | | | | |
| Studienleistung | Yes 10 % | Form Subject theoretical practical work | Description Studierenden e Wissen zu eir demonstrieren Versuches m Diskussion. Dar Gruppe eine Übr | nem bestim dieses in nit Präse rüber hinau ungsaufgab | nmten Thema, Form eines ntation und s betreut jede e, die inhaltlich |
| Examination | Written exam | | | | |
| Examination duration and scale | 120 min | | | | |



| | General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: |
|---------------------|--|
| | Compulsory |
| | Electrical Engineering: Core qualification: Compulsory |
| Following Curricula | General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory |
| _ | General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: |
| | Compulsory |
| | Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective |
| | Compulsory |

| Course L0720: Electroni | c Devices | | | | |
|-------------------------|---|--|--|--|--|
| Тур | Lecture | | | | |
| Hrs/wk | 3 | | | | |
| СР | 4 | | | | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | | | | |
| Lecturer | Prof. Hoc Khiem Trieu | | | | |
| Language | DE | | | | |
| Cycle | WiSe | | | | |
| Content | Uniformly doped semiconductor (semiconductor, crystal structure, energy band diagram, effective mass, density of state, probability of occupancy, mass action law, generation and recombination processes, generation and recombination lifetime, carrier transport mechanisms: drift current, diffusion current; equilibriums in semiconductor, semiconductor equations) pn-junction (zero applied bias, energy band diagram in thermal equilibrium, current-voltage characteristics, derivation of diode equation, consideration of space charge recombination, transient behaviour, breakdown mechanisms, various types of diodes: Zener diode, tunnel diode, backward diode, photo diode, LED, laser diode) Bipolar transistor (principle of operation, current-voltage characteristics: calculation of base, collector and emitter current, operating modes; non-ideality: actual doping profile, Early effect, breakdown, generation and recombination current and high injection; Ebers-Moll model: family of characteristics, equivalent circuit; frequency response, switching characteristics, heterojunction bipolar transistor) Unipolar devices (surface effects: surface states, work function, energy band diagram; metal-semiconductor junctions: Schottky contact, current-voltage characteristics, ohmic contact; junction field effect transistor: operating principle, current-voltage characteristics, small-signal model, breakdown characteristics; MESFET: operating principle, depletion mode and enhancement mode MESFET; MIS structure: accumulation, depletion, inversion, strong inversion, flatband voltage, oxide charges, threshold voltage, capacitance voltage characteristics; MOSFET: basic structure, principle of operation, current voltage characteristics, frequency response, subthreshold behaviour, threshold voltage, device scaling; CMOS) | | | | |
| Literature | S.M. Sze: Semiconductor devices, Physics and Technology, John Wiley & Sons (1985)F. Thuselt: Physik der Halbleiterbauelemente, Springer (2011) T. Thille, D. Schmitt-Landsiedel: Mikroelektronik, Halbleiterbauelemente und deren Anwendung in elektronischen Schaltungen, Springer (2004) B.L. Anderson, R.L. Anderson: Fundamentals of Semiconductor Devices, McGraw-Hill (2005) D.A. Neamen: Semiconductor Physics and Devices, McGraw-Hill (2011) M. Shur: Introduction to Electronic Devices, John Wiley & Sons (1996) S.M. Sze: Physics of semiconductor devices, John Wiley & Sons (2007) H. Schaumburg: Halbleiter, B.G. Teubner (1991) A. Möschwitzer: Grundlagen der Halbleiter-&Mikroelektronik, Bd1 Elektronische Halbleiterbauelemente, Carl Hanser (1992) HG. Unger, W. Schultz, G. Weinhausen: Elektronische Bauelemente und Netzwerke I, Physikalische Grundlagen der Halbleiterbauelemente, Vieweg (1985) | | | | |



| Course L0721: Electronic Devices | | |
|----------------------------------|---|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Hoc Khiem Trieu | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0783: Me | easurements: Metl | nods and Data Pro | cessing | | |
|---|--|-----------------------------|----------------------------|---------|----|
| Courses | | | | | |
| Title | | | Тур | Hrs/wk | СР |
| EE Experimental Lab (L0781 | | | Practical Course | 2 | 2 |
| Measurements: Methods an Measurements: Methods an | 0 (, | | Lecture | 2 | 3 |
| | 1 | | Recitation Section (small) | 1 | 1 |
| | Prof. Alexander Schlaef | er | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | المساسف والماكم الماكونا والماكون الماكون | | | | |
| Educational Objectives | After taking part success | sfully, students have reach | ned the following learning | results | |
| Professional Competence | | | | | |
| Knowledge | The students are able to explain the purpose of metrology and the acquisition and processing of measurements. They can detail aspects of probability theory and errors, and explain the processing of stochastic signals. Students know methods to digitalize and describe measured signals. | | | | |
| Skills | The students are able to evaluate problems of metrology and to apply methods for describing and processing of measurements. | | | | |
| Personal Competence | | | | | |
| Social Competence | The students solve prob | lems in small groups. | | | |
| Autonomy | The students can reflect their knowledge and discuss and evaluate their results. | | | | |
| Workload in Hours | Independent Study Time | e 110, Study Time in Lectu | ire 70 | | |
| Credit points | 6 | | | | |
| Studienleistung | Compulsory Bonus Yes 10 % | Form Excercises | Description | | |
| Fyamination | Written exam | LVCELCI9G9 | | | |
| Examination duration | | | | | |
| and scale | | | | | |
| Assignment for the Following Curricula | | | | | |



| Course L0781: EE Exper | rimental Lab | |
|------------------------|--|--|
| Тур | Practical Course | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Alexander Schlaefer, Prof. Christian Schuster, Prof. Thanh Trung Do, Prof. Rolf-Rainer Grigat, Prof. Arne Jacob, Prof. Herbert Werner, Dozenten des SD E, Prof. Heiko Falk | |
| Language | DE | |
| Cycle | WiSe | |
| Content | lab experiments: digital circuits, semiconductors, micro controllers, analog circuits, AC power, electrical machines | |
| Literature | Wird in der Lehrveranstaltung festgelegt | |

| Course L0779: Measure | ments: Methods and Data Processing |
|-----------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Alexander Schlaefer |
| Language | DE |
| Cycle | WiSe |
| | introduction, systems and errors in metrology, probability theory, measuring stochastic signals, describing measurements, acquisition of analog signals, applied metrology |
| Literature | Puente León, Kiencke: Messtechnik, Springer 2012 Lerch: Elektrische Messtechnik, Springer 2012 Weitere Literatur wird in der Veranstaltung bekanntgegeben. |

| Course L0780: Measurements: Methods and Data Processing | | |
|---|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Alexander Schlaefer | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | | | |
|--|--|---------------------|----------------------|---------------------------------------|---------------|----------------|
| litle | | | | Тур | Hrs/wk | СР |
| ntroduction to Control Systentroduction to Control Syste | , , | | | Lecture Recitation Section (small) | 2 2 | 4 2 |
| Module Responsible | Prof. Herbert | Werner | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous Knowledge | - | on of signals and | systems in time and | d frequency domain, Lap | lace transfor | m |
| Educational Objectives | After taking p | art successfully, s | tudents have reach | ed the following learning | results | |
| Professional Competence | | | | | | |
| Knowledge | Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequency response They can explain issues arising when controllers designed in continuous time domain are implemented digitally | | | | | |
| Skills | Students can transform models of linear dynamic systems from time to frequency domain and vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks | | | | | |
| Personal Competence | | | | | | |
| Social Competence | | _ | roups to jointly sol | ve technical problems, | and experim | entally valida |
| Autonomy | their controller designs Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress. | | | | | |
| Workload in House | Independent | Study Time 124 | Study Time in Lectu | re 56 | | |
| Credit points | Independent Study Time 124, Study Time in Lecture 56 | | | | | |
| Studienleistung | | | | | | |
| | Written exam | | | | | |
| Examination duration and scale | | | | | | |



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

General Engineering Science (English program): Core qualification: Compulsory

Assignment for the General Englowing Curricula Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory



Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective

Compulsory

Process Engineering: Core qualification: Compulsory

| Course L0654: Introduct | ion to Control Systems | | |
|-------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 4 | | |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 | | |
| Lecturer | Prof. Herbert Werner | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Signals and systems Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle Root locus techniques Root locus design of PID controllers Frequency response techniques Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Time delay systems Root locus and frequency response of time delay systems Smith predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course | | |
| Literature | Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N. 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010 | | |



| Course L0655: Introduction to Control Systems | | |
|---|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Herbert Werner | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | | | |
|---|--|--|--|--------------|-----------------|--|
| Title | | | Тур | Hrs/wl | CP | |
| Semiconductor Circuit Design (L0763) Semiconductor Circuit Design (L0864) | | Lecture Recitation Section (sm | 3 nall) 1 | 4 2 | | |
| Module Responsible | Prof. N | Matthias Kuhl | | | | |
| Admission Requirements | None | | | | | |
| | Funda | mentals of electrical engine | ering | | | |
| Recommended Previous Knowledge | | | | | | |
| Educational Objectives | After ta | aking part successfully, stud | ents have reached the following lear | ning results | | |
| Professional Competence | | | | | | |
| Knowledge | Students are able to explain the functionality of different MOS devices in electronic circuits. Students know the fundamental digital logic circuits and can discuss their advantages at disadvantages. Students have solid knowledge about memory circuits and can explain their functionality at specifications. Students are able to explain how analog circuits functions and where they are applied. Students know the appropriate fields for the use of bipolar transistors. | | | | | |
| Skills | Students can calculate the specifications of different MOS devices and can define the parameters of electronic circuits. Students are able to develop different logic circuits and can design different types of logicircuits. Students can use MOS devices, operational amplifiers and bipolar transistors for special applications. | | | | | |
| Personal Competence | | | | | | |
| Social Competence | Students are able work efficiently in heterogeneous teams. Students working together in small groups can solve problems and answer profession questions. | | | | | |
| Autonomy | • | Students are able to asses | s their level of knowledge. | | | |
| Workload in Hours | Indepe | endent Study Time 124, Stu | dy Time in Lecture 56 | | | |
| Credit points | 6 | | | | | |
| Studienleistung | None | | | | | |
| Examination | Writter | n exam | | | | |
| Examination duration and scale | 120 m | in | | | | |
| | Gener Mecha Gener Comp | ral Engineering Science (Gatronics: Compulsory ral Engineering Science (Gulsory | rman program): Specialisation Electr German program): Specialisation M erman program, 7 semester): Speciali rman program, 7 semester): Speciali | lechanical E | ingineering, Fo | |



| | Focus Mechatronics: Compulsory Electrical Engineering: Core qualification: Compulsory |
|--|--|
| Assignment for the Following Curricula | General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective |
| | Compulsory Mechanical Engineering: Specialisation Mechatronics: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Core qualification: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory |

| | ductor Circuit Design |
|------------|--|
| | Lecture |
| Hrs/wk | |
| СР | |
| | Independent Study Time 78, Study Time in Lecture 42 |
| | Prof. Matthias Kuhl |
| Language | |
| Cycle | SoSe |
| Content | Basic circuits with MOS transistors for logic gates and amplifiers Typical applications for analog and digital circuits Realization of logical functions Memory circuits Scaling-down of CMOS circuits and further perfomance improvements Operational amplifiers and their applications Basic circuits with bipolar transistors Design of exemplary circuits Electrical behavoir of BiCMOS circuits From the summer semester 2017 onwards, students have the possibility to get a bonus of 0,3 to 0,7 fo improving the (passed) exam by writing a test on either the 16.05., 13.06. or the 04.07.2017. The test includes 10 questions (time limit: 20 min.). |
| Literature | R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011 ISBN: 047170055S HG. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674 K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944 U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage 2012, ISBN 3540428496 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://dx.doi.org/10.1007/978-3-642-20887-4 URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955 URL: http://www.ciando.com/img/bo |



| Course L0864: Semiconductor Circuit Design | | | | |
|--|--|--|--|--|
| Тур | Recitation Section (small) | | | |
| Hrs/wk | 1 | | | |
| СР | 2 | | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | | |
| Lecturer | Prof. Matthias Kuhl | | | |
| Language | DE | | | |
| Cycle | SoSe | | | |
| Content | Basic circuits with MOS transistors for logic gates and amplifiers Typical applications for analog and digital circuits Realization of logical functions Memory circuits Scaling-down of CMOS circuits and further perfomance improvements Operational amplifiers and their applications Basic circuits with bipolar transistors Design of exemplary circuits Electrical behavoir of BiCMOS circuits | | | |
| Literature | R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 047170055S HG. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674 K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944 U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://dx.doi.org/10.1007/978-3-642-20887-4 URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955 URL: http://www.ciando.com/img/bo | | | |



| Module M0829: Fo | undations of Management | | | |
|--|---|--|------------------|---------------------|
| Courses | | | | |
| Title Management Tutorial (L088) Introduction to Management | | Typ Recitation Section (large) Lecture | Hrs/wk 2 3 | CP 3 3 |
| Module Responsible | 1 | | | |
| Admission Requirements | | | | |
| Recommended Previous Knowledge | I Racic Knowiadda of Wathamatice and Rijcina | SS | | |
| | After taking part successfully, students have re | eached the following learning | results | |
| Professional Competence | | | | |
| | After taking this module, students know the in Management, from Planning and Organisati and Controlling. In particular they are able to | on to Marketing and Innovati | on, and als | o to Investmen |
| Knowledge | explain the differences between Economics and Management and the sub Management and to name important definitions from the field of Management explain the most important aspects of and goals in Management and name the aspects of entreprneurial projects describe and explain basic business functions as production, procurement supply chain management, organization and human ressource management management, innovation management and marketing explain the relevance of planning and decision making in Business, esp. in simultiple objectives and uncertainty, and explain some basic methods from Finance state basics from accounting and costing and selected controlling methods. | | | |
| Skills | Students are able to analyse business units with respect to different criteria (organization, objective strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to analyse Management goals and structure them appropriately analyse organisational and staff structures of companies apply methods for decision making under multiple objectives, under uncertainty and under ris analyse production and procurement systems and Business information systems analyse and apply basic methods of marketing select and apply basic methods from mathematical finance to predefined problems apply basic methods from accounting, costing and controlling to predefined problems | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a coher report on the project to communicate appropriately and to cooperate respectfully with their fellow students. | | | vrite a coheren |
| Autonomy | Students are able to work in a team and to organize the teator to write a report on their project. | m themselves | | |
| | Independent Study Time 110, Study Time in L | ecture 70 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| | Subject theoretical and practical work | | | |
| Examination duration | | | | |



and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

Assignment for the Following Curricula

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:



Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

| Course L0882: Management Tutorial | | | |
|-----------------------------------|--|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Christoph Ihl, Katharina Roedelius, Tobias Vlcek | | |
| Language | DE | | |
| Cycle | WiSe/SoSe | | |
| Content | In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools. If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on self-selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the business knowledge from the lecture should come to practical use. The group projects are guided by a mentor. | | |
| Literature | Relevante Literatur aus der korrespondierenden Vorlesung. | | |



| | ion to Management |
|-------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona |
| Language | DE |
| Cycle | WiSe/SoSe |
| Content | Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects |
| Literature | Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006. |



| Module M0734: Ele | ectrical Engineering Project Labora | tory | | |
|--|---|---|---------------|---------------------------------------|
| Социосо | | | | |
| Courses | | T | Hua tada | 0.0 |
| Title Electrical Engineering Project Laboratory (L0640) | | Typ Project-/problem-based Learning | Hrs/wk 5 | CP 6 |
| Module Responsible | Prof. Christian Becker | | | |
| Admission Requirements | None | | | |
| • | Electrical Engineering I, Electrical Engineering II | | | |
| Recommended Previous Knowledge | | | | |
| Educational Objectives | I | hed the following learning | results | |
| Professional Competence | | <u> </u> | | |
| Knowledge | Students are able to give a summary of the technical details of projects in the area of electric engineering and illustrate respective relationships. They are capable of describing an communicating relevant problems and questions using appropriate technical language. They can | | | lescribing and |
| Skills | The students can transfer their fundamental knowledge on electrical engineering to the process of solving practical problems. They identify and overcome typical problems during the realization of projects in the context of electrical engineering. Students are able to develop, compare, and choose conceptual solutions for non-standardized problems. | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to cooperate in small, mixed-subject groups in order to independently deriv solutions to given problems in the context of electrical engineering. They are able to effectively prese and explain their results alone or in groups in front of a qualified audience. Students have the ability | | | ectively presen ave the ability to |
| Autonomy | Students are capable of independently solving electrical engineering problems using provide literature. They are able to fill gaps in as well as extent their knowledge using the literature and othe sources provided by the supervisor. Furthermore, they can meaningfully extend given problems and pragmatically solve them by means of corresponding solutions and concepts. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lect | ture 70 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Subject theoretical and practical work | | | |
| Examination duration and scale | based on task + presentation | | | |
| Assignment for the Following Curricula | General Engineering Science (German program General Engineering Science (German prograr Compulsory Electrical Engineering: Core qualification: Comp General Engineering Science (English program) General Engineering Science (English progran | n, 7 semester): Specialisa ulsory : Specialisation Electrical I | tion Electric | al Engineering |



Compulsory
Technomathematics: Specialisation III. Engineering Science: Elective Compulsory
Technomathematics: Core qualification: Elective Compulsory

| Course L0640: Electrical Engineering Project Laboratory | | | | |
|---|--|--|--|--|
| Тур | Project-/problem-based Learning | | | |
| Hrs/wk | ; | | | |
| СР | 6 | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | |
| Lecturer | Prof. Christian Becker, Dozenten des SD E | | | |
| Language | DE | | | |
| Cycle | SoSe | | | |
| Content | Topics and projects cover the entire field of applications of electrical engineering. Typically, the students will prototype functional units and self-contained systems, such as radar devices, networks of sensors, amateur radio transceiver, power electronics based inverters, discrete computers, or atomic force microscopes. Different projects are devised on a yearly basis. | | | |
| Literature | Alle zur Durchführung der Projekte sinnvollen Quellen (Skripte, Fachbücher, Manuals, Datenblätter, Internetseiten). / All sources that are useful for completion of the projects (lecture notes, textbooks, manuals, data sheets, internet pages). | | | |



Specialization Energy and Environmental Engineering

One of the main challenges in modern society is the reliable, environmentally benign and sustainable supply of energy. An efficient energy supply is moreover essential to secure the economic future of the country.

The exponential increase in world population, the raised living standards and the continuously increasing hunger for feedstocks, acreage and energy make imperative the sustainable handling of natural resources. This includes the reduction of emissions and the minimisation of environmental impact. An example with growing significance is the control of the CO_2 emissions that are responsible for the greenhouse effect. For this, possibilities are sought that bring energy savings or involve increased use of renewable energy sources. In a continued utilisation of fossil fuels the reduction of CO_2 emissions is pursued by increasing efficiency and also through separation and underground storage of the CO_2 emitted. The latter approaches make a close cooperation between Energy Engineering and Environmental Engineering unavoidable.

The study specialisation in Energy and Environmental Engineering of the degree General Engineering Science responds to two developments: on the one hand the increasing significance of environmental protection through CO₂ separation in large power stations and, on the other, the growing supply of electricity from regenerative energy sources. Both these key developments in electricity generation are taken into consideration in designing the degree course. Not only for the CO₂ separation technologies but also for other environmental protection purposes, as for example air pollution protection, key qualifications in Chemistry play an important role. Conventional and renewable electricity generation technologies are covered in the degree more detailed but still under a generalist viewpoint.

The study specialisation in Energy and Environmental Engineering of the degree General Engineering Science conveys a wide and well-founded multidisciplinary fundamental knowledge in the disciplines of Energy Engineering and of Environmental Engineering. Extending a well-grounded understanding in the core qualifications over basic engineering methods (mathematics, mechanics, thermodynamics, fluid mechanics, physics, chemistry, electrical engineering, informatics and engineering construction) additional skills are conveyed in energy technology, environmental assessment, environmental technology, materials science and particle technology, along with non-technical subjects. These provide necessary qualifications for elaborating the supporting processes during system development. At the skills level the Bachelor degree prepares the student for a Master study or even a PhD research too, so that after graduation also professional qualifications suitable for a potential future research career are gained.

| Courses | | | | |
|-----------------------------------|--|---|---------------|--------------|
| Title | Ту | /p | Hrs/wk | СР |
| Computer Engineering (L032 | 21) Led | ecture | 3 | 4 |
| Computer Engineering (L032 | 24) Re | ecitation Section (small) | 1 | 2 |
| Module Responsible | | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Basic knowledge in electrical engineering The successful completion of the labs will be he examination according to the following rules: 1. Upon a passed module examination, the stumarks due to the successful labs, such that respectively, up to the next-better grade. 2. The improvement of the grade 5,0 up to 4,3 and | udent is granted a bo the examination's ma | onus on the | e examinatio |
| Educational Objectives | After taking part successfully, students have reached t | the following learning | results | |
| Professional Competence | This module deals with the foundations of the function from the assembly-level programming down to gates. • Introduction • Combinational logic: Gates, Boolean alge- | The module includes | the following | g topics: |



Knowledge

combinational networks

- Sequential logic: Flip-flops, automata, systematic hardware design
- Technological foundations
- Computer arithmetic: Integer addition, subtraction, multiplication and division
- Basics of computer architecture: Programming models, MIPS single-cycle architecture, pipelining
- Memories: Memory hierarchies, SRAM, DRAM, caches
- Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-point connections, busses

The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physical composition of computer systems. The students can analyze, how highly specific and individual computers can be built based on a collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers of today's computing systems - from gates and circuits up to complete processors.

Skills After successful completion of the module, the students are able to judge the interdependencies between a physical computer system and the software executed on it. In particular, they shall understand the consequences that the execution of software has on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to propose feasible options.

Personal Competence

Social Competence

Students are able to solve similar problems alone or in a group and to present the results accordingly.

Autonomy

Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes.

Workload in Hours Independent Study Time 124, Study Time in Lecture 56

90 minutes, contents of course and labs

Credit points 6

| Studienleistung | Compulsory | Bonus | Form | Description |
|-----------------|------------|-------|------------|-------------|
| | Yes | 10 % | Excercises | |
| | | | | |

Examination Written exam

Examination duration and scale

General Engineering Science (German program): Core qualification: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering:

Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and

Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory



General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory Assignment for the General Engineering Science (English program, 7 semester): Specialisation Computer Science: **Following Curricula** Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation II. Informatics: Elective Compulsory

| Course L0321: Compute | er Engineering | | |
|-----------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | | | |
| СР | 4 | | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | | |
| Lecturer | Prof. Heiko Falk | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output | | |
| Literature | A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. | | |



| Course L0324: Computer Engineering | | |
|------------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0933: Fu | ndamentals of Materials Science | e | | |
|--|---|----------------------------|-------------------|----------------|
| Courses | | | | |
| | | Trees | Llup hade | CD |
| Title Fundamentals of Materials S | Science I (I 1085) | Typ Lecture | Hrs/wk 2 | CP 2 |
| | Science I (Advanced Ceramic Materials, Polyn | nore and | | |
| Composites) (L0506) | , | Lecture | 2 | 2 |
| Physical and Chemical Basi | cs of Materials Science (L1095) | Lecture | 2 | 2 |
| Module Responsible | Prof. Jörg Weißmüller | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | | athematics | | |
| Educational Objectives | After taking part successfully, students have | e reached the following le | arning results | |
| Professional | | | | |
| Competence | | | | |
| Knowledge | The students have acquired a fundamental knowledge on metals, ceramics and polymers and can describe this knowledge comprehensively. Fundamental knowledge here means specifically the issues of atomic structure, microstructure, phase diagrams, phase transformations, corrosion and mechanical properties. The students know about the key aspects of characterization methods for materials and can identify relevant approaches for characterizing specific properties. They are able to trace materials phenomena back to the underlying physical and chemical laws of nature. | | | |
| Skills | The students are able to trace materials phenomena back to the underlying physical and chemica laws of nature. Materials phenomena here refers to mechanical properties such as strength, ductility and stiffness, chemical properties such as corrosion resistance, and to phase transformations such as solidification, precipitation, or melting. The students can explain the relation between processing conditions and the materials microstructure, and they can account for the impact of microstructure or the material's behavior. | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | | | | |
| - | Independent Study Time 96, Study Time in | Lecture 84 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| | Written exam | | | |
| Examination duration and scale | 180 min | | | |
| | General Engineering Science (Germa | n program): Specialisa | tion Energy and | Enviromenta |
| | Engineering: Compulsory | | otion Masteri | l Facility of |
| | General Engineering Science (Germa Compulsory General Engineering Science (German pro General Engineering Science (German pro | ogram): Specialisation Bio | medical Engineeri | ng: Compulsory |
| | General Engineering Science (German pro Compulsory | | | |
| | General Engineering Science (German pro Compulsory General Engineering Science (German | | | |
| | Compulsory General Engineering Science (Germa | | | |
| | I | | | |



| | Enviromental Engineering: Compulsory | | |
|---------------------|--|--|--|
| | Energy and Environmental Engineering: Core qualification: Compulsory | | |
| | General Engineering Science (English program): Specialisation Energy and Environmental | | |
| Following Curricula | Engineering: Compulsory | | |
| _ | General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory | | |
| | General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory | | |
| | General Engineering Science (English program): Specialisation Naval Architecture: Compulsory | | |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: | | |
| | Compulsory | | |
| | General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: | | |
| | Compulsory | | |
| | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: | | |
| | Compulsory | | |
| | General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental | | |
| | Engineering: Compulsory | | |
| | Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory | | |
| | Mechanical Engineering: Core qualification: Compulsory | | |
| | Mechatronics: Core qualification: Compulsory | | |
| | Naval Architecture: Core qualification: Compulsory | | |
| | Technomathematics: Specialisation III. Engineering Science: Elective Compulsory | | |

| Course L1085: Fundame | entals of Materials Science I |
|-----------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Jörg Weißmüller |
| Language | DE |
| Cycle | WiSe |
| Content | |
| Literature | Vorlesungsskript W.D. Callister: Materials Science and Engineering - An Introduction. 5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7 |

| Course L0506: Fundame | entals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) |
|-----------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Bodo Fiedler, Prof. Gerold Schneider |
| Language | DE |
| Cycle | SoSe |
| Content | Chemische Bindungen und Aufbau von Festkörpern; Kristallaufbau; Werkstoffprüfung; Schweißbarkeit; Herstellung von Keramiken; Aufbau und Eigenschaften der Keramik; Herstellung, Aufbau und Eigenschaften von Gläsern; Polymerwerkstoffe, Makromolekularer Aufbau; Struktur und Eigenschaften der Polymere; Polymerverarbeitung; Verbundwerkstoffe |
| Literature | Vorlesungsskript W.D. Callister: Materials Science and Engineering -An Introduction-5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7 |



| Course L1095: Physical | and Chemical Basics of Materials Science | | |
|------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Stefan Müller | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Motivation: "Atoms in Mechanical Engineering?" Basics: Force and Energy The electromagnetic Interaction "Detour": Mathematics (complex e-funktion etc.) The atom: Bohr's model of the atom Chemical bounds The multi part problem: Solutions and strategies Descriptions of using statistical thermodynamics Elastic theory of atoms Consequences of atomar properties on makroskopic Properties: Discussion of examples (metals, semiconductors, hybrid systems) | | |
| Literature | Für den Elektromagnetismus: Bergmann-Schäfer: "Lehrbuch der Experimentalphysik", Band 2: "Elektromagnetismus", de Gruyter Für die Atomphysik: Haken, Wolf: "Atom- und Quantenphysik", Springer Für die Materialphysik und Elastizität: Hornbogen, Warlimont: "Metallkunde", Springer | | |



| Module M0598: Me | echanical Enginee | ering: Design | | | |
|-----------------------------------|--|--|------------------------------------|---------|----|
| Courses | | | | | |
| Title | | | Тур | Hrs/wk | СР |
| Embodiment Design and 3D | -CAD (L0268) | | Lecture | 2 | 1 |
| Mechanical Design Project I | (L0695) | | Project-/problem-based Learning | 3 | 2 |
| Mechanical Design Project I | I (L0592) | | Project-/problem-based Learning | 3 | 2 |
| Team Project Design Metho | dology (L0267) | | Project-/problem-based Learning | 2 | 1 |
| Module Responsible | Prof. Dieter Krause | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | Mechanics | f Mechanical Engineering f Materials Science neering | Design | | |
| Educational Objectives | After taking part success | sfully, students have reach | ed the following learning | results | |
| Professional Competence | | | | | |
| - Сотренение | After passing the modul | e, students are able to: | | | |
| Knowledge | explain design guidelines for machinery parts e.g. considering load situation, materials and | | | | |
| Skills | After passing the module, students are able to: independently create sketches, technical drawings and documentations e.g. using 3D CAD, design components based on design guidelines autonomously, dimension (calculate) used components, use methods to design and solve engineering design tasks systamtically and solution-oriented, apply creativity techniques in teams. | | | | |
| Personal Competence | ¦ | a atudosta ava abla tar | | | |
| Social Competence | After passing the module, students are able to: develop and evaluate solutions in groups including making and documenting decisions, moderate the use of scientific methods, present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course. | | | | |
| Autonomy | Students are able • to estimate their level of knowledge using activating methods within the lectures (e.g. with clickers), • To solve engineering design tasks systematically. | | | | |
| Workload in Harris | Indonondant Study Time | o 40. Study Timo in Locture | . 140 | | |
| Credit points | | e 40, Study Time in Lecture | 5 1+U | | |
| Studienleistung | Compulsory Bonus Yes None Yes None Yes None | Form Written elaboration Written elaboration Written elaboration | Description | | |
| | Yes None | Written elaboration | | | |
| | Written exam | | | | |
| Examination duration | | | | | |



| and scale | 180 |
|----------------------|--|
| | General Engineering Science (German program): Specialisation Energy and Enviromental |
| | Engineering: Compulsory |
| | General Engineering Science (German program): Specialisation Mechanical Engineering: |
| | Compulsory |
| | General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Energy and |
| | Enviromental Engineering: Compulsory |
| Assignment for the | Energy and Environmental Engineering: Core qualification: Compulsory |
| Following Curricula | 11-eneral Engineering Science (English program). Specialisation Energy and Environmentall |
| 1 Ollowing Ourricula | Engineering: Compulsory |
| | General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory |
| | General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental |
| | Engineering: Compulsory |
| | Mechanical Engineering: Core qualification: Compulsory |
| | Mechatronics: Core qualification: Compulsory |
| | Naval Architecture: Core qualification: Compulsory |

| ourse L0268: Embodim | ent Design and 3D-CAD | | | | |
|----------------------|---|--|--|--|--|
| Тур | Lecture | | | | |
| Hrs/wk | 2 | | | | |
| СР | | | | | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | | | | |
| Lecturer | of. Dieter Krause | | | | |
| Language | DE | | | | |
| Cycle | WiSe | | | | |
| Content | Basics of 3D CAD technology Practical course to apply a 3D CAD system Introduction to the system Sketching and creation of components Creation of assemblies Deriving technical drawings | | | | |
| Literature | CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K. Springer-Verlag, aktuelle Auflage. Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage. Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H. Hesser, W; Cornelsen, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. | | | | |



| Course L0695: Mechanic | cal Design Project I | | | |
|------------------------|--|--|--|--|
| Тур | Project-/problem-based Learning | | | |
| Hrs/wk | 3 | | | |
| СР | | | | |
| Workload in Hours | ependent Study Time 18, Study Time in Lecture 42 | | | |
| Lecturer | Prof. Thorsten Schüppstuhl | | | |
| Language | DE | | | |
| Cycle | WiSe | | | |
| Content | Create a technical documentation of an existing mechanical model Consolidation of the following aspects of technical drawings: Presentation of technical objects and standardized parts (bearings, seals, shaft-hub joints, detachable connections, springs, axes and shafts) Sectional views Dimensioning Tolerances and surface specifications Creating a tally sheet | | | |
| Literature | Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011. Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008. Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005. | | | |

| Course L0592: Mechanic | cal Design Project II |
|------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 3 |
| СР | 2 |
| Workload in Hours | Independent Study Time 18, Study Time in Lecture 42 |
| Lecturer | Prof. Wolfgang Hintze |
| Language | DE |
| Cycle | SoSe |
| Content | Generation of sketches for functions and sub-functions Approximately calculation of shafts Dimension of bearings, screw connections and weld Generation of engineering drawings (assembly drawings, manufacturing drawing) |
| Literature | Dubbel, Taschenbuch für Maschinenbau, Beitz, W., Küttner, KH, Springer-Verlag. Maschinenelemente, Band I - III, Niemann, G., Springer-Verlag. Maschinen- und Konstruktionselemente, Steinhilper, W., Röper, R., Springer-Verlag. Einführung in die DIN-Normen, Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G., Beitz, W., Springer-Verlag. |



| Course L0267: Team Pro | oject Design Methodology | | | | |
|------------------------|---|--|--|--|--|
| Тур | Project-/problem-based Learning | | | | |
| Hrs/wk | | | | | |
| СР | 1 | | | | |
| Workload in Hours | ndependent Study Time 2, Study Time in Lecture 28 | | | | |
| Lecturer | Prof. Dieter Krause | | | | |
| Language | DE | | | | |
| Cycle | SoSe | | | | |
| Content | Introduction to engineering designing methodology Team Project Design Methodology Creating requirement lists Problem formulation Creating functional structures Finding solutions Evaluation of the found concepts Documentation of the taken methodological steps and the concepts using presentation slides | | | | |
| Literature | Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen | | | | |



| Courses | | | | | | | |
|---|---|--|--|---|--|-------------|----------------|
| Title | | | | Тур | | Hrs/wk | СР |
| Fundamentals of Fluid Mechanics (L0091) Fluid Mechanics for Process Engineering (L0092) | | | | Lectur Recita | e tion Section (large) | 2 2 | 4 2 |
| Module Responsible | Prof. Michael S | hlüter | | | | | |
| Admission Requirements | None | | | | | | |
| Recommended Previous Knowledge | | | | | | | |
| Educational Objectives | After taking par | successi | fully, students h | ave reached the | following learning | results | |
| Professional Competence | | | | | | | |
| Knowledge | give an engineeexplain | he differe overviev ring | v for different ations of the | | low he Reynolds Tra Navier-Stokes-E | | - |
| Skills | reduce solutionnotice th | and mod the gover se.g. by i e depend | rning equation ntegration dency between | theory and techr | matically nics by simplificat nical applications ations in fields of p | | · |
| Personal Competence | | | | | | | |
| Social Competence | informat able to results e are able | on to the vork toge ffectively | context of the lether on subjection in English (e.gout solutions for | ecture and it related tasks in during small gro | lated, professional small groups. Th oup exercises) emselves, to discus | ey are able | to present the |
| Autonomy | | urther lite | | | and their knowledç ate their actual kno | | |
| Workload in Hours | Independent St | udy Time | 124, Study Tim | ne in Lecture 56 | | | |
| Credit points | 6 | | | | | | |
| Studienleistung | Compulsory BonusFormDescriptionYes5 %Midterm | | | | | | |
| Examination | Written exam | | | | | | |
| Examination duration and scale | 2 hours | | | | | | |



| | General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory | | | | |
|---|---|--|--|--|--|
| | General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory | | | | |
| | Reneral Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory | | | | |
| | General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory | | | | |
| Assignment for the Following Curricula | Bioprocess Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory | | | | |
| | General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory | | | | |
| | General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory | | | | |
| | General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory | | | | |
| | General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory | | | | |
| | Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Process Engineering: Core qualification: Compulsory | | | | |

| Course I 0091 · Fundame | entals of Fluid Mechanics |
|-------------------------|--|
| | Lecture |
| Hrs/wk | |
| СР | |
| | Independent Study Time 92, Study Time in Lecture 28 |
| | Prof. Michael Schlüter |
| Language | |
| Cycle | |
| Content | fluid properties hydrostatic overall balances - theory of streamline overall balances- conservation equations differential balances - Navier Stokes equations irrotational flows - Potenzialströmungen flow around bodies - theory of physical similarity turbulent flows compressible flows |
| Literature | Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994. Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006. Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008. Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007. Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008. Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011. |



| ourse L0092: Fluid Med | chanics for Process Engineering | | | |
|------------------------|--|--|--|--|
| Тур | Recitation Section (large) | | | |
| Hrs/wk | 2 | | | |
| СР | | | | |
| Workload in Hours | ndependent Study Time 32, Study Time in Lecture 28 | | | |
| Lecturer | rof. Michael Schlüter | | | |
| Language | DE | | | |
| Cycle | SoSe | | | |
| Content | In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into application. For that, the students receive example tasks for download. The students solve these problems based on the lecture material either independently or in small groups. The solution is discussed with the students under scientific supervision and parts of the solutions are presented on the chalk board. At the end of each exercise-lecture, the correct solution is presented on the chalk board. Parallel to the exercise-lecture tutorials are held where the student solve exam questions under a set time-frame in small groups and discuss the solutions afterwards. | | | |
| Literature | Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994. Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006. Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008. Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007. Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008. Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011. | | | |



| Module M0610: Ele | ectrical machines | | | |
|--------------------------------|--|---|---|---|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Electrical Machines (L0293) | | Lecture | 3 | 4 |
| Electrical Machines (L0294) | | Recitation Section (large) | 2 | 2 |
| Module Responsible | Prof. Thanh Trung Do | | | |
| Admission Requirements | None | | | |
| Recommended | Basics of mathematics, in particular complex | e numbers, integrals, differenti | als | |
| | Basics of electrical engineering and mechan | ical engineering | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | |
| Professional Competence | | | | |
| | Students can to draw and explain the basic | principles of electric and magn | etic fields. | |
| Knowledge | They can describe the function of the standard types of electric machines and present the corresponding equations and characteristic curves. For typically used drives they can explain the major parameters of the energy efficiency of the whole system from the power grid to the drive engine. | | | |
| | Students arw able to calculate two-dimensio circuits with air gap. For this they apply the u | | • | - |
| Skills | They can calulate the operational performan and selected quantities and characteristic graphical methods. | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | Students are able independently to calcula able to analyse independently the operation data and theycan calculate thereof selected | al performance of electric mach | nines from th | |
| Workload in Hours | Independent Study Time 110, Study Time in | Lecture 70 | | |
| Credit points | <u> </u> | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 120 Minuten | | | |
| Assignment for the | General Engineering Science (German Engineering: Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German Environmental Engineering: Compulsory General Engineering Science (German prog Elective Compulsory Electrical Engineering: Core qualification: Electrical Engineering: Core qualification: Electrical Engineering: Core Constant Engineering: Core Core Core Constant Engineering: Core Core Core Core Core Core C | ogram): Specialisation Mecha program, 7 semester): Specialisation ram, 7 semester): Specialisation ective Compulsory re qualification: Compulsory | nical Engin pecialisation on Mechanic | eering: Electiv n Energy an cal Engineering |
| Following Curricula | achoral Engineering Colonico (Engilon | ogram): Specialisation Mecha | nical Engin | eering: Electiv |



Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering:

Elective Compulsory

Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core qualification: Elective Compulsory

Mechatronics: Core qualification: Compulsory

| Course L0293: Electrica | l Machines | |
|-------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| СР | 4 | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | |
| Lecturer | of. Thanh Trung Do | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Electric field: Coulomb´s law, flux (field) line, work, potential, capacitor, energy, force Magnetic field: force, flux line, Ampere´s law, field at bounderies, flux, magnetic circuit, hysteresis, induction, self-induction, mutual inductance, transformer DC-Machines: Construction and layout, torque generation mechanismen, torque vs speed characteristics, commutation, Asynchronous Machines. Magnetic field, construction and layout, equivalent single line diagram, complex stator current diagram (Heylands´diagram), torque vs. speed characteristics, rotor layout (Squirrelcage vs. sliprings), Synchronous machines, construction and layout, equivalent single line diagrams, no-load and short-cuircuit characteristics, vector diagrams, motor and generator operation drives with variable speed, inverter fed operation, special drives, step motors, | |
| Literature | Hermann Linse, Roland Fischer: "Elektrotechnik für Maschinenbauer", Vieweg-Verlag; Signatur der Bibliothek der TUHH: ETB 313 Ralf Kories, Heinz Schmitt-Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122 "Grundlagen der Elektrotechnik" - anderer Autoren Fachbücher "Elektrische Maschinen" | |



| Course L0294: Electrica | l Machines |
|-------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Thanh Trung Do, Weitere Mitarbeiter |
| Language | DE |
| Cycle | SoSe |
| Content | Exercises to the application of electric and magnetic fields. Excercises to the operational performance of eletric machines. |
| Literature | Hermann Linse, Roland Fischer: "Elektrotechnik für Maschinenbauer", Vieweg-Verlag; Signatur der Bibliothek der TUHH: ETB 313 Ralf Kories, Heinz Schmitt-Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122 "Grundlagen der Elektrotechnik" - anderer Autoren Fachbücher "Elektrische Maschinen" |



| Courses | | | | |
|--|--|---|---------------|-------------------------------|
| Title | | Тур | Hrs/wk | СР |
| Power Industry (L0316) | | Lecture | 1115/WK | 1 |
| Energy Systems and Energy | y Industry (L0315) | Lecture | 2 | 2 |
| Renewable Energy (L0313) | | Lecture | 2 | 2 |
| Renewable Energy (L1434) | | Recitation Section (small) | 1 | 1 |
| Module Responsible | Prof. Martin Kaltschmitt | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | none | | | |
| Educational Objectives | After taking part successfully, students have re | eached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | systems and their economic efficiency. They can explain the issues occurring in this contex Furthermore, they can explain details of power generation, power distribution and power trading wi regard to subject-related contexts. The students can explain these aspects, which are applicable to many energy systems in general, especially for renewable energy systems and critical discuss them Furthermore, the students can explain the environmental benefits from the use of such systems. | | | |
| Skills | Students are able to apply methodologies for detailed determination of energy demand or energy production for various types of energy systems. Furthermore, they can evaluate energy system technically, environmentally and economically and design them under certain given condition. Therefore, they can choose the necessary subject-specific calculation rules, also for not standardize solutions of a problem. The students are able to explain questions and possible approaches to its processing from the field of renewable energies or ally and to put them them into the right context. | | | |
| Dava and Commetence | | - | | |
| Social Competence | The students are able to analyze suitable to economical and ecological criteria under sus contribuition to a more sustainable power sup | tainability aspects. This allow | | |
| Autonomy | Students can independently exploit sources, acquire the particular knowledge about the subject are and transform it to new questions. | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Le | cture 84 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 3 hours written exam | | | |
| Assignment for the Following Curricula | General Engineering Science (German Engineering: Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German progr Focus Energy Systems: Elective Compulsory Energy and Environmental Engineering: Core General Engineering Science (English Engineering: Compulsory | program, 7 semester): S am, 7 semester): Specialisation qualification: Compulsory | pecialisation | n Energy ar cal Engineerin |



General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Elective Compulsory

| Course L0316: Power Inc | dustry |
|-------------------------|---|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Martin Kaltschmitt, Prof. Andreas Wiese |
| Language | DE |
| Cycle | SoSe |
| Content | Electrical energy in the energy system Demand and use of electrical energy (households, industry, "new" buyers (including emobility)) Electricity generation electricity generation technologies using fossil fuels and their characteristics combined heat and power technologies and their production characteristics electricity generation from renewable energy technologies and their characteristics Power distribution "classic" distribution of electrical energy challenges of fluctuating electricity generation by distributed systems (electricity market, electricity stock exchange, emissions trading) District heating industry Legal and administrative aspects Energy Act support instruments for renewable energy CHP Act Cost and efficiency calculation |
| Literature | Folien der Vorlesung |

| Causa I 0215, France C | Vistame and Fuerway Indicators | | |
|-------------------------|--|--|--|
| Course Lus 15: Energy S | systems and Energy Industry | | |
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Martin Kaltschmitt | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Energy: development and significance Fundamentals and basic concepts Energy demand and future trends (heat, electricity, fuels) Energy reserve and sources Cost and efficiency calculation Final and effective energy from petroleum, natural gas, coal, uranium and other Legal, administrative and organizational aspects of energy systems Energy systems as a permanent optimization task | | |
| Literature | Kopien der Folien | | |



| Course L0313: Renewak | ole Energy | | |
|-----------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Martin Kaltschmitt | | |
| Language | DE/EN | | |
| Cycle | SoSe | | |
| Content | introduction solar energy for heat and power generation wind power for electricity generation hydropower for electricity generation ocean energy for electricity generation geothermal energy for heat and electricity generation | | |
| Literature | Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - System technik, Wirtschaft lichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007 | | |

| Course L1434: Renewal | ole Energy | |
|-----------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Martin Kaltschmitt | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | Students work on different tasks in the field of renewable energies. They present their solutions in the exercise lesson and discuss it with other students and the lecturer. Possible tasks in the field of renewable energies are: Solar thermal heat Concentrating solare power Photovoltaic Windenergie Hydropower Heat pump Deep geothermal energy | |
| Literature | Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - System technik, Wirtschaft lichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007 | |



| Courses | | | | |
|---|--|--|---|---|
| Title Heat and Mass Transfer (Li Heat and Mass Transfer (Li Heat and Mass Transfer (Li | 0102) | Typ Lecture Recitation Section (small) Recitation Section (large) | Hrs/wk 2 1 | CP 2 2 2 |
| Module Responsible | , ! | necitation Section (large) | 1 | 2 |
| Admission Requirements | | | | |
| Recommended Previous Knowledge | Basic knowledge: Technical Thermodynar | nics | | |
| Educational Objectives | After taking part successfully, students hav | re reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The students are capable of explaining qualitative and determining quantitative heat transfer in procedural apparatus (e. g. heat exchanger, chemical reactors). They are capable of distinguish and characterize different kinds of heat transfer mechanisms namely heat conduction, heat transfer and thermal radiation. The students have the ability to explain the physical basis for mass transfer in detail and to describe mass transfer qualitative and quantitative by using suitable mass transfer theories. They are able to depict the analogy between heat- and mass transfer and to describe complex linked processes in detail. | | | |
| Skills | The students are able to set reason using the gained knowledge and respectively. They are capable to solve specific temperature alteration in fluids) and Using dimensionless quantities, the apparatus. They are able to distinguish between They can use this knowledge for column, rectification column). In this context, the students are can mass exchanger for a specific apprespectively. In addition, they can calculate both apparatus. The students are capable to connection of other courses (In particular the process engineering) to solve conditions. | d to balance the corresponding fic heat transfer problems (e.g. d to calculate the corresponding e students can execute scaling the en diffusion, convective mass to the description and design of pable to choose and design fur plication considering their advant, steady-state and non-steady-state ect their knowledge obtained in a courses thermodynamics, flui | heated cheat flows. up of technic ransition and fapparatus adamental tyentages and tate process this course | emical reactors cal processes of d mass transfer (e.g. extraction pes of heat and disadvantages es in procedura |
| Personal Competence Social Competence | The students are capable to work rocults orally in a reasonable many | | in teams an | d to present the |
| | The students are able to find and e They are able to prove their leprocedure continuously (clicker-symmetry) | vel of knowledge during the | course with | accompanying |



| Autonomy | control their learning processes. | |
|---|---|--|
| | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | |
| Credit points | | |
| Studienleistung | | |
| Examination | Written exam | |
| Examination duration and scale | I 120 minutes: theoretical questions and calculations | |
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Core qualification: Compulsory | |



| Course L0101: Heat and | Mass Transfer |
|------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Irina Smirnova |
| Language | DE |
| Cycle | WiSe |
| Content | 1. Heat transfer Introduction, one-dimensional heat conduction Convective heat transfer Multidimensional heat conduction Non-steady heat conduction Thermal radiation Mass transfer one-way diffusion, equimolar countercurrent diffusion boundary layer theory, non-steady mass transfer Heat and mass transfer single particle/ fixed bed Mass transfer and chemical reactions |
| Literature | H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer VDI-Wärmeatlas |

| Course L0102: Heat and | Course L0102: Heat and Mass Transfer | |
|------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Irina Smirnova | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L1868: Heat and | Course L1868: Heat and Mass Transfer | |
|------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Irina Smirnova | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0546: Th | nermal Separation Processes | | | |
|---|--|---|--|------------------|
| Courses | | | | |
| Title Thermal Separation Proces Thermal Separation Proces Thermal Separation Proces | ses (L0119) ses (L0141) | Typ Lecture Recitation Section (small) Recitation Section (large) | Hrs/wk 2 2 1 | CP 2 2 1 |
| Separation Processes (L11 | 59) | Practical Course | 1 | 1 |
| Module Responsible | Prof. Irina Smirnova | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | | nics III | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The students can distinguish and describe different types of separation processes such as distillation, extraction, and adsorption The students develop an understanding for the course of concentration during a separation process, the estimation of the energy demand of a process, the possibilities of energy saving and the selection of separation systems They have good knowledge of designing methods for separation processes and devices | | | |
| Skills | Using the gained knowledge the students can select a reasonable system boundary for a give separation process and can close the associated energy and material balances The students can use different graphical methods for the designing of a separation process and define the amount of theoretical stages required They can select and design a basic type of thermal separation process for a given case base on the advantages and disadvantages of the process The students are capable to obtain independently the needed material properties for appropriate sources (diagrams and tables) They can calculate continuous and discontinuous processes The students are able to prove their theoretical knowledge in the experimental lab work. The students are able to discuss the theoretical background and the content of experimental work with the teachers in colloquium. The students are capable of linking their gained knowledge with the content of other lectures and it together for the solution of technical problems. Other lectures such as thermodynamics, fl mechanics and chemical engineering. | | aration proces ven case base properties fror ab work. content of the | |
| Personal Competence | | | | |
| Social Competence | The students can work technical a results in the tutorial The students are able to carry out pr division of labor between them. The scientifically in a report. | actical lab work in small group | os and orgar | nize a functiona |
| Autonomy | The students are capable to obtathemselves and assess their quality The students can proof the state of the this way control their learning proces | neir knowledge with exam rese | | |



| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 | |
|---|--|--|
| Credit points | | |
| Studienleistung | | |
| Examination | Written exam | |
| Examination duration and scale | 120 minutes; theoretical questions and calculations | |
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering: Compulsory General Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory | |



| Тур | Lecture | |
|-------------------|---|--|
| Hrs/wk | | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Irina Smirnova | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes | |
| Literature | G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter of Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 17985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry's Chemical Engineers' Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg 6th ed., McGraw-Hill, New York 1984 Ullmann's Enzyklopädie der Technische Chemie | |



| urse L0119: Thermal | Separation Processes | | | | |
|---------------------|---|--|--|--|--|
| Тур | Recitation Section (small) | | | | |
| Hrs/wk | | | | | |
| СР | 2 | | | | |
| Workload in Hours | dependent Study Time 32, Study Time in Lecture 28 | | | | |
| Lecturer | Prof. Irina Smirnova | | | | |
| Language | DE | | | | |
| Cycle | WiSe | | | | |
| Content | Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes The students work on tasks in small groups and present their results in front of all students. | | | | |
| Literature | G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed. McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie | | | | |



| urse L0141: Thermal | Separation Processes | | | | | |
|---------------------|--|--|--|--|--|--|
| Тур | Recitation Section (large) | | | | | |
| Hrs/wk | | | | | | |
| СР | 1 | | | | | |
| Workload in Hours | dependent Study Time 16, Study Time in Lecture 14 | | | | | |
| Lecturer | of. Irina Smirnova | | | | | |
| Language | | | | | | |
| Cycle | WiSe | | | | | |
| Content | Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes | | | | | |
| Literature | G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie | | | | | |



| Course L1159: Separation | on Processes | | |
|--------------------------|---|--|--|
| Тур | Practical Course | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | ndependent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | rof. Irina Smirnova | | |
| Language | E/EN | | |
| Cycle | | | |
| Content | The students work on eight different experiments in this practical course. For every one of the eight experiments, a colloquium takes place in which the students explain and discuss the theoretical background and its translation into practice with staff and fellow students. The students work small groups with a high degree of division of labor. For every experiment, the students write a report. They receive instructions in terms of scientific writing as well as feedback on their own reports and level of scientific writing so they can increase their capabilities in this area. Topics of the practical course: Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes | | |
| Literature | G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie | | |



| Courses | | | | | | |
|---|--|----------------------|---------------------------------------|---------|--------|--|
| Title | | | Тур | Hrs/wk | СР | |
| Gas and Steam Power Plants (L0206) Gas and Steam Power Plants (L0210) | | | Lecture Recitation Section (large) | 3 2 | 4 2 | |
| Module Responsible | Prof. Alfons Kather | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous Knowledge | "Technical Therr"Heat Transfer""Fluid Mechanical | modynamics I and I | Į" | | | |
| Educational Objectives | After taking part success | sfully, students hav | e reached the following learning | results | | |
| Professional Competence | | | | | | |
| Knowledge | The students can evaluate the development of the electricity demand and the energy conversion routes in the thermal power plant, describe the various types of power plant and the layout of the steam generator block. They are also able to determine the operation characteristics of the power plant. Additionally they can describe the exhaust gas cleaning apparatus and the combination possibilities of conventional fossil-fuelled power plants with solar thermal and geothermal power plants or plants equipped with Carbon Capture and Storage. | | | | | |
| | The students have basic knowledge about the principles, operation and design of turboma | | | | | |
| Skills | Within the framework of the exercise the students learn the use of the specialised software sui EBSILON Professional TM . With this tool small practical tasks are solved with the PC, to highlig aspects of the design and development of power plant cycles. The students are able to do simplified calculations on turbomachinery either as part of a plant, a | | | | | |
| | single component or at | stage level. | | | | |
| Social Competence | An excursion within the framework of the lecture is planned for students that are interested. The students get in this manner direct contact with a modern power plant in this region. The students will be a modern power plant in this region. | | | | | |
| Autonomy | The students assisted by the tutors will be able to develop alone simple simulation models and rule with these scenario analyses. In this manner the theoretical and practical knowledge from the lecture is consolidated and the potential effects from different process combinations and boundary condition highlighted. The students are able independently to analyse the operational performance of stear | | | | | |
| Workload in Hours | Independent Study Time | e 110, Study Time i | n Lecture 70 | | | |
| Credit points | 6 | | | | | |
| | | | | | | |



| Studienleistung | No | 5 % | Attestation | EBSILON Professional; nur bestanden/nicht bestanden (keine | |
|--------------------------------|--|--|---|--|--|
| | No | 5 % | Excercises | anteili៉្យាទេ៣កិច្ចមុនសម្រៀaben im Laufe der Vorlesungen à 5 Minuten; bis zu 5 % Bonus je nach Anteil richtiger Abgaben | |
| Examination | Written exam | 1 | | | |
| Examination duration and scale | Written exam | Written examination of 120 min | | | |
| _ | Engineering: General Eng Energy Syste General Eng Enviromenta General Eng Focus Energ Energy and B General Eng Engineering: General Eng Energy Syste General Eng Engineering: General Eng Engineering: General Eng Focus Energ | Compulsory gineering Scients: Compuls gineering Scients: Compuls gineering Scients: Elements of the Scients: Compulsory gineering Scients: Scients: Elements gineering Scients gineering | ence (German program): Speciory cience (German program, 7 cience (German program, 7 ce (German program, 7 semestective Compulsory clience (English program): Speciory cience (English program): Speciory core (English program, 7 semester) | Specialisation Energy and Enviromental cialisation Mechanical Engineering, Focus ter): Specialisation Energy and Enviromental ter): Specialisation Mechanical Engineering, | |



| Course L0206: Gas and | Steam Power Plants | | | | | |
|-----------------------|--|--|--|--|--|--|
| Тур | Lecture | | | | | |
| Hrs/wk | 3 | | | | | |
| СР | 4 | | | | | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | | | | | |
| | Prof. Alfons Kather | | | | | |
| Language | | | | | | |
| Cycle | | | | | | |
| | In the 1 st part of the lecture an overview on thermal power plants is offered, including: | | | | | |
| Content | Electricity demand and Forecasting Thermodynamic fundamentals Energy Conversion in thermal power plants Types of power plant Layout of the power plant block Individual elements of the power plant Cooling systems Flue gas cleaning Operation characteristics of the power plant Construction materials for power plants Location of power plants Solar thermal plants/geothermal plants/Carbon Capture and Storage plants. These are complemented in the 2 nd part of the module by the more specialised issues: Energy balance of a turbomachine Theory of turbine and compressor stage Equal and positive pressure blading Flow losses Characteristic numbers Axial and radial design Design features Hydraulic turbomachines Pump and water turbine designs Design examples of reciprocating engines and turbomachinery Steam power plants Gas turbine systems. | | | | | |
| Literature | Kalide: Kraft- und Arbeitsmaschinen Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985 Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006 Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990 Bohn, T. (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke, Heizkraftwerke und Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland | | | | | |



| Tren | Recitation Section (large) | | | | |
|-------------------|--|--|--|--|--|
| | | | | | |
| Hrs/wk | - | | | | |
| СР | - | | | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | | | |
| Lecturer | Prof. Alfons Kather | | | | |
| Language | DE | | | | |
| Cycle | WiSe | | | | |
| Content | In the 1st part of the lecture a general introduction into fluid-flow machines and steam power plant offered, including: • Energy balance of a fluid-flow machine • Theory of turbine and compressor stage • Equal and positive pressure blading • Flow losses • Characteristic numbers • Axial and radial design • Design features • Hydraulic fluid-flow machines • Pump and water turbine designs • Design examples of reciprocating engines and turbomachinery • Steam power plants • Gas turbine systems • Diesel engine systems • Diesel engine systems • Waste heat utilisation followed by the more specialised issues: • Electricity Demand and Forecasting • Thermodynamic fundamentals • Energy Conversion in Thermal Power Plants • Types of Power Plant • Layout of the power plant block • Individual elements of the power plant • Cooling systems | | | | |
| | Flue gas cleaning Operation characteristics of the power plant Construction materials Location of power plants The environmental impact of acidification, fine particulate or CO ₂ emissions and the resulting clima effects are a special focus of the lecture and the lecture hall exercise. The challenges in pleoperation from interconnecting conventional power plants and renewable energy sources a discussed and the technical options for providing security of supply and network stability apresented, also under consideration of cost effectiveness. In this critical review, focus is especially placed on the compatibility of the different solutions with the environment and climate. With this, awareness for the responsibility of an engineer's own actions are emphasized and the potential extra of the different solutions presented clearly. Within the framework of the exercise the students learn the use of the specialised software suffers and development of power plant cycles. The students present their results orally and of afterwards ask questions and get feedback. The course work has a positive effect on the students figrade. | | | | |
| Literature | Skripte Kalide: Kraft- und Arbeitsmaschinen Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985 Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006 Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990 T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke Heizkraftwerke und Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland | | | | |



| Courses | | | | | | | | |
|---|--|--|---|---|--|--|--|--|
| | | | Tun | Hrs/wk | CD | | | |
| Title Practical Course: Measurement and Control Systems (L1119) | | | Typ Practical Course | Hrs/WK 2 | CP 2 | | | |
| | or Mechanical and Process Engineers (| L1116) | Lecture | 2 | 3 | | | |
| | or Mechanical and Process Engineers (| | Recitation Section (large) | 1 | 1 | | | |
| Module Responsible | Dr. Sven Krause | | | | | | | |
| Admission Requirements | | | | | | | | |
| | Basic knowledge of physics, chem | Basic knowledge of physics, chemistry and electrical engineering | | | | | | |
| | After taking part successfully, stude | ents have reach | ed the following learning | results | | | | |
| Professional | | | | | | | | |
| Competence | | | | | | | | |
| Knowledge | Students are able to name the most important fundmentals of the Measurement Tech (Quantities and Units, Uncertainty, Calibration, Static and Dynamic Properties of Senso Systems). They can outline the most important measuring methods for different kinds of quantities maesured (Electrical Quantities, Temperature, mechanical quantities, Flow, Time, Frequency). | | | | | | | |
| | They can describe important methods of chemical Analysis (Gas Sensors, Spectroscopy, Ga Chromatography) | | | | | | | |
| Skills | Students can select suitable measuring methods to given problems and can use refering measurement devices in practice. The students are able to orally explain issues in the subject area of measurement technology and solution approaches as well as place the issues into the right context and application area. | | | | | | | |
| Personal Competence | | | | | | | | |
| Social Competence | Students can arrive at work results in groups and document them in a common report. | | | | | | | |
| Autonomy | Students are able to familiarize themselves with new measurement technologies. | | | | | | | |
| Workload in Hours | Independent Study Time 110, Stud | ly Time in Lectu | re 70 | | | | | |
| Credit points | <u> </u> | | | | | | | |
| · | Compulsory Bonus Form | | Description | | | | | |
| Studienleistung | | | | | | | | |
| Examination | Written exam | | | | | | | |
| Examination duration | | | | | | | | |
| | General Engineering Science Engineering: Compulsory General Engineering Science Compulsory General Engineering Science (Ger General Engineering Science (Ger General Engineering Science Enviromental Engineering: Comput General Engineering Science (Ger Compulsory General Engineering Science (Ger Compulsory | (German program): rman program): (German program) Ilsory rman program, 7 | gram): Specialisation Specialisation Biomedic Specialisation Process E gram, 7 semester): S 7 semester): Specialisation | Mechanica al Engineeri Engineering: pecialisation on Mechanic | I Engineerir ng: Compulso Compulsory n Energy a cal Engineerir | | | |



General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

Assignment for the Energy and Environmental Engineering: Core qualification: Compulsory

Following Curricula General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

> General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory

> General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory

> General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

> General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



| Тур | Practical Course |
|-------------------|---|
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | NN |
| Language | DE |
| Cycle | WiSe/SoSe |
| | Experiment 1: Emission and immission measurement of gaseous pollutants: different technologie determine different gaseous pollutants in automotive exhaust are used. |
| Content | Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dyna behaviour of e pump engine will be investigated. The starting will be simulated on a PC and compa with measurement. |
| | Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will understood and applications with Michelson interferometer and optical fibers demonstrated. |
| | Experiment 4:Identification of the parameters of a control system and optimal control parameters |
| | Versuch 1: Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974 Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmit Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979 Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenhei Naturschutz und Umweltgestaltung Gebrauchs- und Bedienungsanweisungen VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 E 2455 Bl.1 Versuch 2: |
| Literature | Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren Simulationsmethoden, speziell: Verwendung von Blockschaltbildern Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze |
| | Versuch 3: Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verl Heidelberg, 1984 Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech Hor Boston, 1988 Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Bost 1989 Versuch 4: Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelunge |



| Tyn | Lecture |
|-------------------|--|
| Hrs/wk | |
| СР | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Dr. Sven Krause |
| Language | |
| Cycle | |
| | 1 Fundamentals |
| | 1.1 Quantities and Units |
| | 1.2 Uncertainty |
| | 1.3 Calibration |
| | 1.4 Static and Dynamic Properties of Sensors and Systems |
| | 2 Measurement of Electrical Quantities |
| | 2.1 Current and Voltage |
| | 2.2 Impedance |
| | 2.3 Amplification |
| | 2.4 Oscilloscope |
| | 2.5 Analog-to-Digital Conversion |
| Cantant | 2.6 Data Transmission |
| Content | 3 Measurement of Nonelectric Quantities |
| | 3.1 Temperature |
| | 3.2 Length, Displacement, Angle |
| | 3.3 Strain, Force, Pressure |
| | 3.4 Flow |
| | 3.5 Time, Frequency |
| | 4 Chemical Analysis |
| | 4.1 Gas Sensors |
| | 4.2 Spectroscopy |
| | 4.3 Gas Chromatography |
| | At the end of each lecture students present single measuring techniques and results orally in from the class. |
| | Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Spring 2006, ISBN: 978-3-540-34055-3. |
| Literature | Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 9: 3486217940. |



| Course L1118: Measurement Technology for Mechanical and Process Engineers | |
|---|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Sven Krause |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M1275: En | vironmental Technology | | | |
|--|---|---|--|---|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Practical Exercise Environm Environmental Technologie (| | Practical Course Lecture | 1 2 | 1 2 |
| Module Responsible | ` ' | Edutard | | |
| Admission | | | | |
| Requirements | None | | | |
| Recommended Previous Knowledge | Fundamentals of inorganic/organic chemical | istry and biology | | |
| | After taking part successfully, students ha | ve reached the following lea | rning results | |
| Professional | | | | |
| Competence | With the completion of this modul th | ne students obtain profour | nd knowledge of | environmenta |
| Knowledge | technology. They are able to describe the give an overview of scientific disciplines is methods. | ne behaviour of chemicals ir | the environmer | nt. Students car |
| Skills | Students are able to propose approprial problems. They are able to determine pollutants to migrate and transform. The Environmental Technology contributes to these opinons in front of and against the Q | e geochemical parameters students are able to work of sustainable development, a | and to assess to ut well founded o | the potential o pinions on how |
| Personal Competence | | | | |
| Social Competence | The students are able to discuss the various technical and scientific tasks, both subject-specific an multidisciplinary. They are able to develop different approaches to the task as a group as well as t discuss their theoretical or practical implementation. | | | |
| Autonomy | Students can independently exploit source tranfer it to new problems. | es about of the subject, acqu | ire the particular | knowledge and |
| Workload in Hours | Independent Study Time 48, Study Time i | n Lecture 42 | | |
| Credit points | | | | |
| Studienleistung | Yes None Form Subject th practical work | Descriptio eoretical and | n | |
| Examination | Written exam | | | |
| Examination duration and scale | 1 hour | | | |
| Assignment for the Following Curricula | General Engineering Science (Germ Engineering: Compulsory General Engineering Science (Germar Compulsory General Engineering Science (Germar Environmental Engineering: Compulsory General Engineering Science (German Elective Compulsory General Engineering Science (German pelective Compulsory Bioprocess Engineering: Core qualification Energy and Environmental Engineering: General Engineering Science (English Engineering: Compulsory General Engineering Science (English Compulsory General Engineering Science (English Compulsory General Engineering Science (English Processes) | n program): Specialisation an program, 7 semester program, 7 semester): Special rogram, 7 semester): Special on: Elective Compulsory Core qualification: Compulsors sh program): Specialisation | Process Engine Dialisation Proce Disation Bioproce Disation Bioproce Disation Bioproce Disation Energy and Disation Energy and | eering: Elective n Energy and ss Engineering ss Engineering H Enviromenta |



General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Elective Compulsory
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Elective Compulsory
Process Engineering: Core qualification: Elective Compulsory

| Course L1387: Practical | Exercise Environmental Technology |
|-------------------------|--|
| Тур | Practical Course |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Joachim Gerth |
| Language | DE |
| Cycle | SoSe |
| Content | The experiment demonstrates the effect of ionic strength on the binding of dissolved zinc and phosphate by soil surfaces. From the results it can be inferred that the potential of soil surfaces is modified by the application of salt. This has consequences for the retention of nutrients and pollutants. The experiment is carried out with iron oxide rich soil material. Within the lab course students discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or practical implementation. |
| Literature | F. Scheffer und P. Schachtschabel (2002): "Lehrbuch der Bodenkunde" TUB Signatur AGG-308 W.E.H. Blum (2007): "Bodenkunde in Stichworten" TUB Signatur AGG-317 C. A. J. Appelo; D. Postma (2005): "Geochemistry, groundwater and pollution" TUB Signatur GWC-515 |

| Course L0326: Environn | nental Technologie |
|------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Joachim Gerth, Prof. Martin Kaltschmitt, Prof. Kerstin Kuchta |
| Language | DE |
| Cycle | WiSe |
| Content | Introductory seminar on environmental science: Environmental impact and adverse effects Wastewater technology Air pollution control Noise protection Waste and recycling management Soil and ground water protection Renewable energies Resource conservation and energy efficiency |
| Literature | Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972-5 (ISBN) |



| courses | | | | |
|--|--|--|--------------|-----------------|
| Title Title | | Тур | Hrs/wk | СР |
| ntroduction to Control Syste ntroduction to Control Syste | , , | Lecture Recitation Section (small) | 2 | 4 2 |
| Module Responsible | Prof. Herbert Werner | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Representation of signals and system | ns in time and frequency domain, Lapl | ace transfor | m |
| Educational Objectives | After taking part successfully, students | s have reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Students can represent dynamic system behavior in time and frequency domain, and can i particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties i terms of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequency response They can explain issues arising when controllers designed in continuous time domain are implemented digitally | | | |
| Skills | Students can transform models of linear dynamic systems from time to frequency domain an vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus an frequency response techniques They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks | | | |
| Personal Competence | | | | |
| Social Competence | | to jointly solve technical problems, a | nd experim | entally validat |
| Autonomy | their controller designs Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress. | | | |
| Workload in Hours | Independent Study Time 124, Study T | Fime in Lecture 56 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| Examination | | | | |
| Examination duration and scale | 120 min | | | |



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Bioprocess Engineering: Core qualification: Compulsory

Focus Energy Systems: Compulsory

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

General Engineering Science (English program): Core qualification: Compulsory

Assignment for the General Englowing Curricula Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory



Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective

Compulsory

Process Engineering: Core qualification: Compulsory

| Course L0654: Introduct | ourse L0654: Introduction to Control Systems | | |
|-------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 4 | | |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 | | |
| Lecturer | Prof. Herbert Werner | | |
| Language | DE | | |
| Cycle | <u>WiSe</u> | | |
| | Signals and systems | | |
| | Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability | | |
| | Feedback systems | | |
| | Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle | | |
| | Root locus techniques | | |
| | Root locus plots Root locus design of PID controllers | | |
| | Frequency response techniques | | |
| Content | Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control | | |
| | Time delay systems | | |
| | Root locus and frequency response of time delay systems Smith predictor | | |
| | Digital control | | |
| | Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers | | |
| | Software tools | | |
| | Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course | | |
| Literature | Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems", Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ, 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010 | | |



| Course L0655: Introduction to Control Systems | |
|---|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Herbert Werner |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | | |
|--|-----------------------------------|--|---------------------------------|-----------------|----------------|
| | | | | | |
| Fitle Particle Technology I (L0434 | 1) | | Typ Lecture | Hrs/wk 2 | CP 3 |
| Particle Technology I (L0435 | • | | Recitation Section (small) | 1 | 1 |
| Particle Technology I (L0440 | | | Practical Course | 2 | 2 |
| Module Responsible | Prof. Stefan Heinrich | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | keine | | | | |
| | After taking part succe | ssfully, students have reache | ed the following learning | results | |
| Professional Competence | | ,, | <u> </u> | | |
| Knowledge | name and expl | letion of the module students lain processes and unit-oper articles, particle distributions | rations of solids process | | |
| Skills | solids propertie asses solids wi | esign apparatuses and proce es of the product ith respect to their behavior in work scientifically. | | | to the desire |
| Personal Competence | | | | | |
| Social Competence | The students are able | to discuss scientific topics or echnical-scientific issues in a | • | or scientific p | ersonal and t |
| Autonomy | · · | nalyze and solve questions r | = - | independentl | y. |
| Workload in Hours | Independent Study Tir | me 110, Study Time in Lectur | e 70 | | |
| Credit points | 6 | | | | |
| | Compulsory Bonus | Form | Description | | |
| Otto all a selections | | Written elaboration | sechs Berichte (5-10 Seiten | pro Versuch | ein Bericht) à |
| Studienleistung | | | | | |
| | Written exam | | | | |
| | 90 minutes | Science (German program): S | Specialisation Process F | ngineering: (| Compulsory |



General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory
Process Engineering: Core qualification: Compulsory

| Course L0434: Particle Technology I | | | |
|-------------------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Stefan Heinrich | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Description of particles and particle distributions Description of a separation process Description of a particle mixture Particle size reduction Agglomeration, particle size enlargement Storage and flow of bulk solids Basics of fluid/particle flows classifying processes Separation of particles from fluids Basic fluid mechanics of fluidized beds Pneumatic and hydraulic transport | | |
| Literature | Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992. | | |

| Course L0435: Particle Technology I | |
|-------------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Stefan Heinrich |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Course L0440: Particle | Fechnology I |
|------------------------|---|
| Тур | Practical Course |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Stefan Heinrich |
| Language | DE/EN |
| Cycle | SoSe |
| Content | Sieving Bulk properties Size reduction Mixing Gas cyclone Blaine-test, filtration Sedimentation |
| Literature | Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992. |



| Courses | | | | |
|-----------------------------------|---|--|------------------|-----------------|
| Title | | Тур | Hrs/wk | СР |
| Environmental Assessment | (L0860) | Lecture | 2 | 2 |
| Environmental Assessment | (L1054) | Recitation Section (sma | ll) 1 | 1 |
| Module Responsible | Prof. Martin Kaltschmitt | | | |
| Admission | None | | | |
| Requirements | | | | |
| Previous Knowledge | Fundamentals of inorganic/organic cher | nistry and biology | | |
| | After taking part successfully, students h | ave reached the following learni | ng results | |
| Professional | | | | |
| Competence | | | | |
| | With the completion of this module the schains of potential environmental problems. | The state of the s | | |
| Knowledge | construction measures. They have known | | • | |
| Miowieage | in dealing with different methods and | | | |
| | students are able to estimate the comple and difficulties with their measurement. | exity of these environmental proc | esses as well | as uncertaintie |
| | The students are able to select a su | | | |
| | assessment methods. Thereby they c environmental problems in a busines | | | |
| Skills | Assessments independently and can | | | |
| | Ecolnvent. After finishing the course th | | ce to critically | judge researc |
| | results or other publications on environr | nentai impacts. | | |
| Personal Competence | | | | |
| | The students are able to discuss the va | | | • |
| | multidisciplinary. They are able to deve practical implementation. Due to the s | | | |
| Social Competence | multi-layered issues of the environment protection and the concept of sustainability. Their sensitivity | | | |
| Social Competence | and consciousness towards these sub their future social responsibilities in their | · · · · · · · · · · · · · · · · · · · | s to raise the | ır awareness o |
| | | | | |
| | | | | |
| | The students learn to research, process | | | |
| Automomy | carry out independent scientific work. The and are able to judge results of other pu | | problem in a b | ousiness contex |
| Autonomy | and and acts to judge recalls of carer pa | | | |
| | | | | |
| Workload in Hours | Independent Study Time 48, Study Time | in Lecture 42 | | |
| Credit points | 3 | | | |
| Studienleistung | | | | |
| | Written exam | | | |
| Examination duration and scale | l 1 hour written exam | | | |
| | General Engineering Science (Gerr | man program): Specialisation | Energy and | d Enviromenta |
| | Engineering: Compulsory General Engineering Science (Germa | an program): Specialisation P | rocess Engine | eering: Electiv |
| | Compulsory | | _ | _ |
| | General Engineering Science (Gerr Enviromental Engineering: Compulsory | | Specialisation | n Energy and |
| | General Engineering Science (Germar | | lisation Proce | ss Engineering |
| | | | | |
| | Elective Compulsory | nrogram 7 competer): Propielie | ation Riggrass | see Enginooring |
| | Elective Compulsory General Engineering Science (German Elective Compulsory | program, 7 semester): Specialis | ation Bioproce | ess Engineerinç |



| Assignment for the | Energy and Environmental Engineering: Core qualification: Compulsory | | | | | |
|---------------------|--|--|--|--|--|--|
| Following Curricula | General Engineering Science (English program): Specialisation Energy and Environmental | | | | | |
| | Engineering: Compulsory | | | | | |
| | General Engineering Science (English program): Specialisation Process Engineering: Elective | | | | | |
| | Compulsory | | | | | |
| | General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental | | | | | |
| | Engineering: Compulsory | | | | | |
| | General Engineering Science (English program, 7 semester): Specialisation Process Engineering: | | | | | |
| | Elective Compulsory | | | | | |
| | General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: | | | | | |
| | Elective Compulsory | | | | | |
| | Process Engineering: Core qualification: Elective Compulsory | | | | | |
| | Process Engineering: Core qualification: Compulsory | | | | | |

| Course L0860: Environmental Assessment | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Dr. Anne Rödl, Dr. Christoph Hagen Balzer | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | Contaminants: Impact- and Risk Assessment Environmental damage & precautionary principle: Environmental Risk Assessment (ERA) Resource and water consumption: Material flow analysis Energy consumption: Cumulated energy demand (CED), cost analysis Life cycle concept: Life cycle assessment (LCA) Sustainability: Comprehensive product system assessment, SEE-Balance Management: Environmental and Sustainability management (EMAS) Complex systems: MCDA and scenario method | |
| Literature | Foliensätze der Vorlesung Studie: Instrumente zur Nachhaltigkeitsbewertung - Eine Synopse (Forschungszentrum Jülich GmbH) | |



| Course L1054: Environn | nental Assessment |
|------------------------|--|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Martin Kaltschmitt |
| Language | DE |
| Cycle | SoSe |
| Content | Presentation and application of free software programs in order to understand the concepts of environmental assessment methods better. Within the group exercise students discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or practical implementation. |
| Literature | Power point Präsentationen |



| Module M0891: Inf | ormatics for Process Engineers | | | |
|--|---|---|--|--|
| Courses | | | | |
| Title Informatics for Process Engineers (L0836) Informatics for Process Engineers (L0837) Numeric and Matlab (L0125) | | Typ Lecture Recitation Section (small) Practical Course | Hrs/wk 2 2 2 | CP 2 2 2 |
| Module Responsible | Dr. Marcus Venzke | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Basic knowledge in using MS Windows. | | | |
| Educational Objectives | After taking part successfully, students have reach | ed the following learning | results | |
| Professional Competence Knowledge | Students can describe procedural and object-oriented concepts. | | | |
| Skills | Students are capable of object-oriented programming in the programing language Java and of solving mathematic questions by using Matlab. Students are capable of developing concepts (simple algorithms) to solve technical questions. | | | |
| Personal Competence Social Competence | Students are able to work out solutions together in | n small groups. | | |
| Autonomy | Students are able to assess acquired skills by applying it in practice. | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture | e 84 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| | Written exam | | | |
| Examination duration and scale | 90 min | | | |
| Assignment for the Following Curricula | General Engineering Science (German prograted Compulsory) General Engineering Science (German program Environmental Engineering: Elective Compulsory) General Engineering Science (German program Elective Compulsory) Bioprocess Engineering: Core qualification: Compulsory and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program Compulsory) General Engineering Science (English program, Tengineering: Elective Compulsory) General Engineering Science (English program Elective Compulsory) Process Engineering: Core qualification: Compulsory | gram, 7 semester): Specialisation 7 semester): Specialisation 7 semester): Specialisation 7 semester): Specialisation 7 semester): Specialisation | pecialisation ation Proces ess Engine n Energy an | Energy and as Engineering: ering: Elective ad Enviromental |



| Course L0836: Informati | cs for Process Engineers |
|-------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Marcus Venzke |
| Language | DE |
| Cycle | SoSe |
| Content | Introduction to object-oriented modelling and programming exemplified with Java Objects, classes Methods, properties Inheritance Basics of the language Java Sample application: Simulation of an electricity network 2D graphics Events and Controls |
| Literature | Campione, Mary; Walrath, Kathy: The Java Tutorial - A practical guide for programmers. Addison-Wesley, Reading, Massachusets, 1998. Bibliothek: TII 978 Krüger, Guido; Hansen, Heiko: Handbuch der Java-Programmierung. 3. Auflage Addison-Wesley, 2002. http://www.javabuch.de/ Krüger, Guido: Go to Java 2. Addison-Wesley Verlag, Bonn, 1999. Bibliothek: TII 717 Cowell, John: Essential Java 2 fast. Springer Verlag, London, 1999. Bibliothek: TII 942 Java SE 7 Documentation http://docs.oracle.com/javase/7/docs/ Java Platform, Standard Edition 7 API Specification http://docs.oracle.com/javase/7/docs/api/ |



| ourse L0837: Informati | cs for Process Engineers |
|------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Marcus Venzke |
| Language | DE |
| Cycle | SoSe |
| Content | In the lab, the content from the lecture is practiced and deepened with practical assignments. Every week one or two programming tasks are assigned. These are solved by the students on computers independently, coached by a tutor. |
| Literature | Campione, Mary; Walrath, Kathy: The Java Tutorial - A practical guide for programmers. Addison-Wesley, Reading, Massachusets, 1998. Bibliothek: TII 978 Krüger, Guido; Hansen, Heiko: Handbuch der Java-Programmierung. 3. Auflage Addison-Wesley, 2002. http://www.javabuch.de/ Krüger, Guido: Go to Java 2. Addison-Wesley Verlag, Bonn, 1999. Bibliothek: TII 717 Cowell, John: Essential Java 2 fast. Springer Verlag, London, 1999. Bibliothek: TII 942 Java SE 7 Documentation http://docs.oracle.com/javase/7/docs/ Java Platform, Standard Edition 7 API Specification http://docs.oracle.com/javase/7/docs/api/ |

| Course L0125: Numeric and Matlab | | |
|----------------------------------|---|--|
| Typ | Practical Course | |
| Hrs/wk | | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Siegfried Rump, Weitere Mitarbeiter | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Programming in Matlab Numerical methods for systems of nonlinear equations Basics in computer arithmetic Linear and nonlinear optimization Condition of problems and algorithms Verified numerical results with INTLAB | |
| Literature | Literatur (Software-Teil): 1. Moler, C., Numerical Computing with MATLAB, SIAM, 2004 2. The Math Works, Inc., MATLAB: The Language of Technical Computing, 2007 3. Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de 4. Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005 | |



| Module M0539: Pr | ocess and Plant En | gineering I | | | | |
|---|---|--|--|---|---|--|
| Courses | | | | | | |
| Title Process and Plant Engineering I (L0095) Process and Plant Engineering I (L0096) Process and Plant Engineering I (L1214) | | | Typ Lecture Recitation Section (large) Recitation Section (small) | Hrs/wk 2 1 | CP 2 2 2 | |
| Module Responsible | 1 | | , , | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous Knowledge | unit operation of thermal a | • | on processes | | | |
| Educational Objectives | After taking part successfu | ılly, students have reache | ed the following learning | results | | |
| Professional Competence | | | | | | |
| Knowledge | classify and formulate blo | classify and formulate blobal balance equations of chemical processes specify linear component equations of complex chemical processes explain linear regression and data reconcilliation problems explain pfd-diagrams | | | | |
| Skills | students are capable of - formulation of mass and energy balance equations and estimation of product streams - estimation of component streams of chemical plants using linear component balance models - solution of data reconcilliation tasks - conduction of process synthesis - economic evaluation of processes and the estimation of production costs | | | | | |
| Personal Competence | | | | | | |
| Social Competence | | | | | | |
| Autonomy | | | | | | |
| Workload in Hours | Independent Study Time 1 | 124, Study Time in Lectur | re 56 | | | |
| Credit points | | | | | | |
| Studienleistung | Yes 10 % | Form Subject theoretical practical work | Description and | | | |
| Examination | Written exam | | | | | |
| Examination duration and scale | 120 Min. lectures notes ar | nd books | | | | |
| Assignment for the Following Curricula | General Engineering Scie General Engineering Scie General Engineering Scie Compulsory General Engineering Scie Compulsory General Engineering Scie Enviromental Engineering: General Engineering Scie General Engineering Scie | ence (German program): sence (German program, pence (German program, pence (German program, pence (German program): Secience (German program): Secience (German program): Secience (English program): Secience (English program): Secience (German program): Secience (G | Specialisation Bioproces 7 semester): Specialisation semester): Specialisation ram, 7 semester): Specialisation bioprocess | s Engineerination Proces on Bioproce pecialisation s Engineerin | ng: Compulsor ss Engineering ss Engineering Energy and | |



General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering:

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Elective Compulsory

Compulsory

Process Engineering: Core qualification: Compulsory

| rse L0095: Process | and Plant Engineering I |
|--------------------|--|
| Тур | Lecture |
| Hrs/wk | |
| СР | |
| | Independent Study Time 32, Study Time in Lecture 28 |
| | Prof. Georg Fieg |
| Language Cycle | |
| Content | 1. Introduction Structure and operation of production plants Operational business process Technical process design Motivation and targets of process development Life cycle of production plants 2. Engineering methods and tools Mass and energy balances Strategies of process synthesis Graphical representation of processes Multidimensional regression Data reconciliation and data validation 3. Process Synthesis Decision levels Experimental process development Reactor synthesis Synthesis of separation processes (process alternatives and criteria for selection) Integration of reaction systems/separation systems (interactions, recycle streams) 4. Process safety 5. Cost estimation of production plants Production costs, capital costs, economic evaluation |
| | S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679 H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74 Behr, W. Ebbers, N. Wiese, ChemIngTech. 72(2000)Nr. 10, S.1157 E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997 M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916 R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte, Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&Co.KGaA, Weinheim, 2004 J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988 G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19 G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306 G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213 G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133 |



| | U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlung Blazek und Bergamann, Frankfurt, 2000 | |
|---|---|--|
| e | J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991 | |

Literature

- T.F. Edgar, D.M. Himmelblau, L.S. Lasdon, Optimization of Chemical Processes, McGraw-Hill, 2001
- G. Gruhn, Vorlesungsmanuskript "Prozess- und Anlagentechnik, TU Hamburg-Harburg
- D. Hairston, Chemical Engineering, October 2001, S. 31-37
- J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2002
- J. Krekel, G. Siekmann, Chem. -Ing.-Tech. 57(1985)Nr. 6, S. 511
- K. Machej, G. Fieg, J. Wojcik, Inz. Chem. Proc., 2(1981), S.815-824
- S. Meier, G. Kaibel, Chem. -Ing.-Tech. 62(1990)Nr. 13, S.169
- J. Mittelstraß, Chem. -Ing.-Tech. 66(1994), S. 309
- P. Li, M. Flender, K. Löwe, G. Wozny, G. Fieg, Fett/Lipid 100(1998), Nr. 12, S. 528-534
- G. Kaibel, Dissertation, TU München, 1987
- G. Kaibel, Chem.-Ing.-Tech. 61 (1989), Nr. 2, S. 104-112
- G. Kaibel, Chem. Eng. Technol., 10(1987), Nr. 2, S. 92-98
- H.J. Lang, Chem. Eng. 54(10),117, 1947
- H.J. Lang, Chem. Eng. 55(6), 112, 1948
- F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76

| Course L0096: Process and Plant Engineering I | |
|---|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Georg Fieg |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L1214: Process | Course L1214: Process and Plant Engineering I | |
|-----------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Georg Fieg | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0829: Fo | undations of Management | | | |
|--|--|---|---|---|
| Courses | | | | |
| Title Management Tutorial (L088) Introduction to Management | | Typ Recitation Section (large) Lecture | Hrs/wk 2 3 | CP 3 3 |
| Module Responsible | Prof. Christoph Ihl | | | |
| Admission Requirements | | | | |
| Recommended Previous Knowledge | I Racic Knowiadda of Wathamatice and Rijcina | SS | | |
| | After taking part successfully, students have re | eached the following learning | results | |
| Professional Competence | | | | |
| | After taking this module, students know the in Management, from Planning and Organisation and Controlling. In particular they are able to | on to Marketing and Innovati | on, and als | o to Investmen |
| Knowledge | explain the differences between Ec Management and to name important of explain the most important aspects of aspects of entreprneurial projects describe and explain basic business supply chain management, organized management, innovation management explain the relevance of planning an multiple objectives and uncertainty, Finance state basics from accounting and costi | efinitions from the field of Mar and goals in Management ar s functions as production, p ation and human ressource t and marketing d decision making in Busine and explain some basic m | nagement and name the procurement management ss, esp. in sethods from | most importar and sourcing ent, information |
| Skills | Students are able to analyse business units with respect to different criteria (organization, objectives strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to • analyse Management goals and structure them appropriately • analyse organisational and staff structures of companies • apply methods for decision making under multiple objectives, under uncertainty and under risk • analyse production and procurement systems and Business information systems • analyse and apply basic methods of marketing • select and apply basic methods from mathematical finance to predefined problems • apply basic methods from accounting, costing and controlling to predefined problems | | | |
| Personal Competence | | | | |
| Social Competence | work successfully in a team of student: to apply their knowledge from the lec report on the project to communicate appropriately and to cooperate respectfully with their felling. | ture to an entrepreneurship p | roject and v | vrite a coheren |
| Autonomy | Students are able to work in a team and to organize the tea to write a report on their project. | m themselves | | |
| | Independent Study Time 110, Study Time in L | ecture 70 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| | Subject theoretical and practical work | | | |
| Examination duration | | | | |



and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

Assignment for the Following Curricula

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:



Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory
Naval Architecture: Core qualification: Compulsory
Technomathematics: Core qualification: Compulsory
Process Engineering: Core qualification: Compulsory

| Course L0882: Management Tutorial | | |
|-----------------------------------|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Christoph Ihl, Katharina Roedelius, Tobias VIcek | |
| Language | DE | |
| Cycle | WiSe/SoSe | |
| Content | In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools. If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on self-selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the business knowledge from the lecture should come to practical use. The group projects are guided by a mentor. | |
| Literature | Relevante Literatur aus der korrespondierenden Vorlesung. | |



| rse L0880: Introduct | ion to Management | | | |
|----------------------|--|--|--|--|
| Тур | Lecture | | | |
| Hrs/wk | 3 | | | |
| СР | 3 | | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | | |
| Lecturer | Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona | | | |
| Language | DE | | | |
| Cycle | WiSe/SoSe | | | |
| Content | Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects | | | |
| Literature | Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttga 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006. | | | |



Specialization Computer Science

The specialization in "Computer Science" allows the graduates to work in the IT sector and to enter Master studies. The Graduates are able to cooperate with Computer Scientists for the design and realization of complex IT tasks. The Graduates should be in the position to adapt to new developments. They should be able to become professionals in almost all branches.

The specialization in "Computer Science" consists of core courses in fundamentals of mathematics and computer science, and specialized courses in software or hardware.

| Module M0561: Dis | screte Algebraic Structures | | | |
|---|--|--|--------------------|---------------------|
| Courses | | | | |
| Title Discrete Algebraic Structure Discrete Algebraic Structure | | Typ Lecture Recitation Section (small | Hrs/wk 2) 2 | CP 3 3 |
| Module Responsible | Prof. Karl-Heinz Zimmermann | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Mathematics from High School. | | | |
| Educational Objectives | After taking part successfully, students | have reached the following learning | ng results | |
| Professional Competence | | | | |
| Knowledge | The students know the important basics of discrete algebraic structures including elementary combinatorial structures, monoids, groups, rings, fields, finite fields, and vector spaces. They also know specific structures like sub sum-, and quotient structures and homomorphisms. | | | |
| Skills | Students are able to formalize and analyze basic discrete algebraic structures. | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to solve specific pro | blems alone or in a group and to pr | resent the res | ults accordingly. |
| Autonomy | Students are able to acquire new knowledge from specific standard books and to associate the acquired knowledge to other classes. | | o associate the | |
| Workload in Hours | Independent Study Time 124, Study Ti | me in Lecture 56 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| | Written exam | | | |
| Examination duration and scale | 120 min | | | |
| | General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory Computer Science: Core qualification: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Technomathematics: Specialisation I. Mathematics: Elective Compulsory | | | |



| Course L0164: Discrete | ourse L0164: Discrete Algebraic Structures | |
|------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Karl-Heinz Zimmermann | |
| Language | DE | |
| Cycle | WiSe | |
| Content | | |
| Literature | | |

| Course L0165: Discrete Algebraic Structures | |
|---|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Karl-Heinz Zimmermann |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | | |
|--|--|--|--|----------------|-----------------|
| Title Computer Engineering (L032 | D1\ | | Typ Lecture | Hrs/wk 3 | CP 4 |
| Computer Engineering (L032 | | | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Heiko Falk | | | | |
| Admission Requirements | None | | | | |
| nequirements | Basic knowledge in elec | trical engineering | | | |
| Recommended | The successful comple examination according to | | e honored during the | evaluation o | f the module's |
| Previous Knowledge | marks due to the respectively, up to | e successful labs, such o the next-better grade. | e student is granted a l that the examination's m ,3 and of 4,3 up to 4,0 is r | arks are lifte | |
| Educational Objectives | After taking part success | fully, students have reac | hed the following learning | g results | |
| Professional Competence | | | | | |
| • | | | nctionality of computing | | |
| Knowledge | from the assembly-level programming down to gates. The module includes the following topics: Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis combinational networks Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture pipelining Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-poin connections, busses | | | | |
| Skills | The students perceive computer systems from the architect's perspective, i.e., they identify the interrestructure and the physical composition of computer systems. The students can analyze, how high specific and individual computers can be built based on a collection of few and simple component. They are able to distinguish between and to explain the different abstraction layers of today computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependenci between a physical computer system and the software executed on it. In particular, they shunderstand the consequences that the execution of software has on the hardware-centric abstraction. | | yze, how highly le components yers of today's erdependencies ular, they shall htric abstraction | | |
| | = | | ates. This way, they will on an entire system's p | | |
| Personal Competence | | | | | |
| Social Competence | Students are able to solv | re similar problems alone | e or in a group and to pre | sent the resu | ts accordingly. |
| Autonomy | Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. | | | | |
| Workload in Hours | Independent Study Time | 124, Study Time in Lect | ure 56 | | |
| Credit points | 6 | | | | |
| Studienleistung | Compulsory Bonus | Form | Description | | |



| Examination duration and scale | 90 minutes, contents of course and labs |
|--------------------------------|--|
| | General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and |
| | Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Energy Systems: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory |
| | General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental |
| | Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Energy Systems: Compulsory |



Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory

| Course L0321: Computer Engineering | | |
|------------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| СР | 4 | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output | |
| Literature | A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. | |

| Course L0324: Computer Engineering | |
|------------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Heiko Falk |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M0553: Ob | ejectoriented Programming, Algori | ithms and Data Struc | tures | |
|-----------------------------------|--|--|--|--|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| | g, Algorithms and Data Structures (L0131) | Lecture | 4 | 4 |
| Objectoriented Programming | g, Algorithms and Data Structures (L0132) | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Rolf-Rainer Grigat | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | l . | ciency in imperative program ata types (integer, double, chaters, and you should have with editor, compiler, linker a of objects and we will not researched. | nming (C, Panar), arrays, used all tho nd debugge epeat the barequisites ar al. The programmer | ascal, Fortran c if-then-else, fo use in your ow er. In this lectur asics mentione the not part of the rams ET, CI an |
| Educational Objectives | After taking part successfully, students have re | ached the following learning | results | |
| Professional | | <u> </u> | | |
| Competence | | | | |
| Knowledge | Students can explain the essentials of softwareference to existing class libraries and design Students can describe fundamental data structof important algorithms for sorting and searching and searc | n patterns. tures of discrete mathematics | | |
| Skills | Students are able to Design software using given design pa Carry out software development and Test Sort and search for data efficiently Assess the complexity of algorithms. | | | |
| Personal Competence | Students can work in teams and communicate | in forums. | | |
| Social Competence | | | | |
| Autonomy | Students are able to solve programming tasks such as LZW data compression using SVN Repositor and Google Test independently and over a period of two to three weeks. | | | |
| Workload in Hours | I Independent Study Time 110, Study Time in Le | ecture 70 | | |
| Credit points | · · · · · · · · · · · · · · · · · · · | | | |
| Studienleistung | | | | |
| | Written exam | | | |
| Examination duration and scale | rbu Minules Conleni of Lecture, exercises and | material in StudIP | | |



| | General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory Computer Science: Core qualification: Compulsory |
|---------------------|--|
| Assignment for the | Electrical Engineering: Core qualification: Compulsory |
| Following Curricula | General Engineering Science (English program): Specialisation Computer Science: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Computer Science: |
| | Compulsory |
| | Computational Science and Engineering: Core qualification: Compulsory |
| | Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory |
| | Technomathematics: Core qualification: Compulsory |

| Course L0131: Objectoriented Programming, Algorithms and Data Structures | | |
|--|---|--|
| Тур | Lecture | |
| Hrs/wk | 4 | |
| СР | 4 | |
| Workload in Hours | Independent Study Time 64, Study Time in Lecture 56 | |
| Lecturer | Prof. Rolf-Rainer Grigat | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Object oriented analysis and design: Objectoriented programming in C++ and Java generic programming UML design patterns Data structures and algorithmes: complexity of algorithms searching, sorting, hash tables, stack, queues, lists, trees (AVL, heap, 2-3-4, Trie, Huffman, Patricia, B), sets, priority queues, directed and undirected graphs (spanning trees, shortest and longest path) | |
| Literature | Skriptum | |

| Course L0132: Objectoriented Programming, Algorithms and Data Structures | |
|--|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Rolf-Rainer Grigat |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | |
|-----------------------------------|---|--|--|---|
| Title | | Тур | Hrs/wk | СР |
| Signals and Systems (L043) | | Lecture | 3 | 4 |
| Signals and Systems (L043) | 1 | Recitation Section (small) | 2 | 2 |
| Module Responsible | Prof. Gerhard Bauch | | | |
| Admission Requirements | None | | | |
| | Mathematics 1-3 | | | |
| | The modul is an introduction to the theory covered by the moduls Mathematik 1-3 is e (Fourier series, Fourier transform, Laplace transform) | xpected. Further experience w | ith spectral | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The students are able to classify and described methods of signal and system theory. The continuous-time and discrete-time signals a signals and systems mathematically in both effects in time domain and image domain signal to a discrete-time signal. | y are able to apply the fund nd systems. They can describe time and image domain. In par | amental tra e and analy ticular, they | nsformations o se deterministi understand th |
| Skills | The students are able to describe and analy using methods of signal and system theory important properties such as magnitude and the impact of LTI systems on the signal properties. | They can analyse and design hase response, stability, line | n basic sys earity etc T | tems regardin |
| Personal Competence | | | | |
| Social Competence | The students can jointly solve specific proble | | | |
| Autonomy | The students are able to acquire relevant information from appropriate literature sources. They ca control their level of knowledge during the lecture period by solving tutorial problems, software tool clicker system. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in | Lecture 70 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 90 min | | | |
| | General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German Engeneering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German prog General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory | ram): Specialisation Computer ram): Specialisation Process E ram): Specialisation Bioproces program): Specialisation program): Specialisation program): Specialisation ram): Specialisation Biomedica gram, 7 semester): Specialisation ram, 7 semester): Specialisation program, 7 semester): Specialisation program | Science: Congineering: s Engineering: s Engineering: Civil- and Mechanica al Engineering tion Electrical sation Contation Procession | Compulsory Compulsory ng: Compulsor Enviromenta I Engineering ng: Compulsor al Engineering nputer Science |



Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Mechatronics: Compulsory

Assignment for the

Following Curricula

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Theoretical Mechanical Engineering: Compulsory

Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,

Focus Theoretical Mechanical Engineering: Compulsory
Computational Science and Engineering: Core qualification: Compulsory

Computational Science and Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



| Course L0432: Signals and Systems | | |
|-----------------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| CP | | |
| | Independent Study Time 78, Study Time in Lecture 42 | |
| Language | Prof. Gerhard Bauch DE/EN | |
| Cycle | | |
| Content | Basic classification and description of continuous-time and discrete-time signals and systems Concvolution Power and energy of signals Correlation functions of deterministic signals Linear time-invariant (LTI) systems Signal transformations: Fourier-Series Fourier Transform Laplace Transform Discrete-time Fourier Transform Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT) Z-Transform Analysis and design of LTI systems in time and frequency domain Basic filter types Sampling, sampling theorem Fundamentals of recursive and non-recursive discrete-time filters | |
| Literature | T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004 K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag. B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner, Stuttgart, 1997 J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002 S. Haykin, B. van Veen: Signals and systems. Wiley. Oppenheim, A.S. Willsky: Signals and Systems. Pearson. Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson. | |



| Course L0433: Signals and Systems | |
|-----------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Gerhard Bauch |
| Language | DE/EN |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M0852: Gr | apn | ineory an | d Optimiza | ation | | | |
|--|---|---|--|---------------------------------------|---|-----------------|---------------------|
| Courses | | | | | | | |
| Title Graph Theory and Optimiza Graph Theory and Optimiza | | | | | Typ Lecture Recitation Section (sma | Hrs/wk 2 11) 2 | CP 3 3 |
| Module Responsible | Prof / | Anusch Taraz | | | | | |
| Admission Requirements | None | WIGOON TUIGE | | | | | |
| Recommended Previous Knowledge | • | Discrete Alg | gebraic Structu s I | ıres | | | |
| Educational Objectives | After t | aking part sud | ccessfully, stud | dents have reach | ned the following learni | na results | |
| Professional Competence | | armig partour | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | 2011011111111111111 | | | |
| Knowledge | • | explain ther Students ca illustrating t | n using appro an discuss loo hese connecti | priate examples | s between these cor of examples. | | - |
| Skills | Students can model problems in Graph Theory and Optimization with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods. Students are able to discover and verify further logical connections between the concepts studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results. | | | | | | |
| Personal Competence | | | | | | | |
| Social Competence | | common lar | nguage. , they can com | nmunicate new o | eams. They are capal concepts according to aples to check and dee | the needs of th | neir cooperating |
| Autonomy | • | can specify Students ha | open question | ns precisely and sufficient persis | derstanding of comple know where to get help tence to be able to wo | in solving the | m. |
| Workload in Hours | Indep | endent Study | Time 124, Stu | ıdy Time in Lectu | ıre 56 | | |
| Credit points | | | | | | | |
| Studienleistung | | | | | | | |
| | Written exam | | | | | | |
| Examination duration and scale | 1120 m | nin | | | | | |
| | Gener Comp | ral Engineeri oulsory | ng Science (| | Specialisation Compu m, 7 semester): Spec | | |



Assignment for the General Engineering Science (English program): Specialisation Computer Science: Compulsory Following Curricula General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory Technomathematics: Specialisation I. Mathematics: Elective Compulsory

| Course L1046: Graph Theory and Optimization | | | | |
|---|---|--|--|--|
| Тур | Lecture | | | |
| Hrs/wk | 2 | | | |
| СР | 3 | | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | | |
| Lecturer | Prof. Anusch Taraz | | | |
| Language | DE | | | |
| Cycle | SoSe | | | |
| Content | Graphs, search algorithms for graphs, trees planar graphs shortest paths minimum spanning trees maximum flow and minimum cut theorems of Menger, König-Egervary, Hall NP-complete problems backtracking and heuristics linear programming duality integer linear programming | | | |
| Literature | M. Aigner: Diskrete Mathematik, Vieweg, 2004 J. Matousek und J. Nesetril: Diskrete Mathematik, Springer, 2007 A. Steger: Diskrete Strukturen (Band 1), Springer, 2001 A. Taraz: Diskrete Mathematik, Birkhäuser, 2012 V. Turau: Algorithmische Graphentheorie, Oldenbourg, 2009 KH. Zimmermann: Diskrete Mathematik, BoD, 2006 | | | |

| Course L1047: Graph Theory and Optimization | | |
|---|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Anusch Taraz | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0727: Sto | ochastics | | | |
|--|--|------------------------------------|---------|--------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Stochastics (L0777) Stochastics (L0778) | | Lecture Recitation Section (small) | 2 2 | 4 2 |
| Module Responsible | Prof. Marko Lindner | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Calculus Discrete algebraic structures (combinatori Propositional logic | ics) | | |
| Educational Objectives | After taking part successfully, students have reach | ned the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Students can explain the main definitions of probability, and they can give basic definitions of modeling elements (random variables, events, dependence, independence assumptions) used in discrete and continuous settings (joint and marginal distributions, density functions). Students can describe characteristic notions such as expected values, variance, standard deviation, and moments. Students can define decision problems and explain algorithms for solving these problems (based on the chain rule or Bayesian networks). Algorithms, or estimators as they are caller, can be analyzed in terms of notions such as bias of an estimator, etc. Student can describe the main ideas of stochastic processes and explain algorithms for solving decision and computation problem for stochastic processes. Students can also explain basic statistical detection and estimation techniques. | | | |
| Skills | Students can apply algorithms for solving decision problems, and they can justify whether approximation techniques are good enough in various application contexts, i.e., students can derive estimators and judge whether they are applicable or reliable. | | | |
| Personal Competence | | | | |
| Social Competence | - Students are able to work together (e.g. on their regular home work) in heterogeneously composed teams (i.e., teams from different study programs and background knowledge) and to present their results appropriately (e.g. during exercise class). | | | |
| Autonomy | Students are capable of checking their understanding of complex concepts on their own. They can specify open questions precisely and know where to get help in solving them. Students can put their knowledge in relation to the contents of other lectures. Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on hard problems. | | | |
| We wished in Herma | ladar and art Chada Tima 104 Chada Tima in Last | FO | | |
| Workload in Hours Credit points | Independent Study Time 124, Study Time in Lectule | ure 56 | | |
| Studienleistung | | | | |
| | Written exam | | | |
| Examination duration and scale | | | | |
| | General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science Compulsory Computer Science: Core qualification: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory | | | |



| Course L0777: Stochast | iics |
|------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Dr. Francisco Javier Hoecker-Escuti |
| Language | EN |
| Cycle | SoSe |
| Content | Foundations of probability theory Definitions of probability, conditional probability Random variables, dependencies, independence assumptions, Marginal and joint probabilities Distributions and density functions Characteristics: expected values, variance, standard deviation, moments Practical representations for joint probabilities Bayessche Netzwerke Semantik, Entscheidungsprobleme, exakte und approximative Algorithmen Stochastic processes Stationarity, ergodicity Correlations Dynamic Bayesian networks, Hidden Markov networks, Kalman filters, queues Detection & estimation Detectors Estimation rules and procedures Hypothesis and distribution tests Stochastic regression |
| Literature | Methoden der statistischen Inferenz, Likelihood und Bayes, Held, L., Spektrum 2008 Stochastik für Informatiker, Dümbgen, L., Springer 2003 Statistik: Der Weg zur Datenanalyse, Fahrmeir, L., Künstler R., Pigeot, I, Tutz, G., Springer 2010 Stochastik, Georgii, HO., deGruyter, 2009 Probability and Random Processes, Grimmett, G., Stirzaker, D., Oxford University Press, 2001 Programmieren mit R, Ligges, U., Springer 2008 |

| Course L0778: Stochastics | | |
|---------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Dr. Francisco Javier Hoecker-Escuti | |
| Language | EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | |
|---|--|---|---|--|
| Title | | Тур | Hrs/wk | СР |
| Automata Theory and Formate Automata Theory and Formate Automata | | Lecture Recitation Section (sr | 2 nall) 2 | 4 2 |
| Module Responsible | Prof. Tobias Knopp | | | |
| Admission Requirements | None | | | |
| | Participating students should be able to | | | |
| Recommended | - specify algorithms for simple data structur | es (such as, e.g., arrays) to | solve computati | onal problems |
| Previous Knowledge | - apply propositional logic and predicate lo | gic for specifying and unde | rstanding mathe | matical proofs |
| | - apply the knowledge and skills taught in t | he module Discrete Algebra | aic Structures | |
| Educational Objectives | After taking part successfully, students hav | e reached the following lear | rning results | |
| Professional Competence | | | | |
| Knowledge | Students can explain syntax, semantics, and decision problems of propositional logic, and they are able to give algorithms for solving decision problems. Students can show correspondences to Boolear algebra. Students can describe which application problems are hard to represent with propositiona logic, and therefore, the students can motivate predicate logic, and define syntax, semantics, and decision problems for this representation formalism. Students can explain unification and resolution for solving the predicate logic SAT decision problem. Students can also describe syntax, semantics, and decision problems for various kinds of temporal logic, and identify their application areas. The participants of the course can define various kinds of finite automata and can identify relationships to logic and formal grammars. The spectrum that students can explain ranges from deterministic and nondeterministic finite automata and pushdown automata to Turing machines. Students can name those formalism for which nondeterminism is more expressive than determinism. They are also able to demonstrate which decision problems require which expressivity, and, in addition, students can transform decision problems w.r.t. one formalism into decision problems w.r.t. other formalisms. They understand that some formalisms easily induce algorithms whereas others are best suited for specifying systems and their properties. Students can describe the relationships between formalisms such as logic, automata, or grammars. | | | |
| Skills | Students can apply propositional logic as Students analyze application problems it temporal logic formulas to represent their particular application problem, and they oproblems to specific formulas. Studen deterministic ones, or derive grammars from work, and they can apply algorithms for the | n order to derive proposin. They can evaluate which can demonstrate the applicate can also transform normautomata and vice versity. | tional logic, pre h formalism is le cation of algorith nondeterministic sa. They can sh | edicate logic, pest suited for nms for decisi automata ir ow how parse |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy Workload in Hours | Indopondent Study Time 104 Ctudy Time : | n Locturo EG | | |
| Credit points | Independent Study Time 124, Study Time i | n Lecture 56 | | |
| Studienleistung | | | | |
| | Written exam | | | |
| Examination duration and scale | | | | |
| and scale | General Engineering Science (German pro General Engineering Science (German Elective Compulsory | | | |



Assignment for the Following Curricula

Computer Science: Core qualification: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Computer Science:

Elective Compulsory

Computational Science and Engineering: Core qualification: Co

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Flective Compulsory

| Course L0332: Automat | a Theory and Formal Languages | | |
|-----------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | | | |
| СР | | | |
| | | | |
| | Independent Study Time 92, Study Time in Lecture 28 | | |
| | Prof. Tobias Knopp | | |
| Language | <u>EN</u> | | |
| Cycle | SoSe | | |
| Content | 1. Propositional logic, Boolean algebra, propositional resolution, SAT-2KNF 2. Predicate logic, unification, predicate logic resolution 3. Temporal Logics (LTL, CTL) 4. Deterministic finite automata, definition and construction 5. Regular languages, closure properties, word problem, string matching 6. Nondeterministic automata: Rabin-Scott transformation of nondeterministic into deterministic automata 7. Epsilon automata, minimization of automata, elimination of e-edges, uniqueness of the minimal automaton (modulo renaming of states) 8. Myhill-Nerode Theorem: Correctness of the minimization procedure, equivalence classes of strings induced by automata 9. Pumping Lemma for regular languages: provision of a tool which, in some cases, can be used to show that a finite automator principally cannot be expressive enough to solve a word problem for some given language 10. Regular expressions vs. finite automata: Equivalence of formalisms, systematic transformation of representations, reductions 11. Pushdown automata and context-free grammars: Definition of pushdown automata, definition of context-free grammars, derivations, parse trees ambiguities, pumping lemma for context-free grammars, transformation of formalisms (from pushdown automata to context-free grammars and back) 12. Chomsky normal form 13. CYK algorithm for deciding the word problem for context-free grammrs 14. Deterministic pushdown automata Soterministic vs. nondeterministic pushdown automata: Application for parsing, LL(k) or LR(k) grammars and parsers vs. deterministic pushdown automata, compiler compiler 16. Regular grammars 17. Outlook: Turing machines and linear bounded automata vs general and context-sensitive grammars 18. Chomsky hierarchy 19. Mealy- and Moore automata: Automata with output (w/o accepting states), infinite state sequences, automata networks 20. Omega automata: Automata for infinite input words, Büchi automata, representation of state transition systems, verification w.r.t. temporal logic specifications (in particular LTL) 21. LT | | |
| Literature | Logik für Informatiker Uwe Schöning, Spektrum, 5. Aufl. Logik für Informatiker Martin Kreuzer, Stefan Kühling, Pearson Studium, 2006 Grundkurs Theoretische Informatik, Gottfried Vossen, Kurt-Ulrich Witt, Vieweg-Verlag, 2010. Principles of Model Checking, Christel Baier, Joost-Pieter Katoen, The MIT Press, 2007 | | |



| Course L0507: Automata Theory and Formal Languages | | |
|--|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Tobias Knopp | |
| Language | EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0803: En | nbedded Systems | | | | |
|---|---|--|--|---|----------------------------------|
| Courses | | | | | |
| Title | | | Тур | Hrs/wk | СР |
| Embedded Systems (L0805 | • | | Lecture | 3 | 4 |
| Embedded Systems (L0806 |) | | Recitation Section | (small) 1 | 2 |
| Module Responsible | Prof. Heiko Falk | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | Computer Engineering | | | | |
| Educational Objectives | After taking part success | sfully, students have reach | ed the following le | earning results | |
| Professional Competence | | | | | |
| | products. This course introduction into these s (models of computation | n be defined as informa teaches the foundations systems (notions, commo n, hierarchical automata, applications, translations | of such system n characteristics) specification of | s. In particular, i and their specific distributed systen | t deals with a ation language |
| Knowledge | Another part covers the hardware of embedded systems: Sonsors, A/D and D/A converters, real-time capable communication hardware, embedded processors, memories, energy dissipation reconfigurable logic and actuators. The course also features an introduction into real-time operating systems, middleware and real-time scheduling. Finally, the implementation of embedded systems using hardware/software co-design (hardware/software partitioning, high-level transformations of specifications, energy-efficient realizations, compilers for embedded processors) is covered. | | | | |
| Skills | After having attended the course, students shall be able to realize simple embedded systems. The students shall realize which relevant parts of technological competences to use in order to obtain a functional embedded systems. In particular, they shall be able to compare different models of computations and feasible techniques for system-level design. They shall be able to judge in which areas of embedded system design specific risks exist. | | | | |
| Personal Competence | | | | | |
| Social Competence | Students are able to solv | ve similar problems alone | or in a group and | to present the resu | ults accordingly. |
| Autonomy | | quire new knowledge fror | n specific literatur | e and to associate | this knowledg |
| Workload in Hours | Independent Study Time | e 124, Study Time in Lectu | re 56 | | |
| Credit points | 6 | | | | |
| | Compulsory Bonus | Form | Descrip | tion | |
| Studienleistung | Yes 10 % | Subject theoretical practical work | and | | |
| Examination | Written exam | | | | |
| Examination duration and scale | 90 minutes, contents of o | course and labs | | | |
| Assignment for the Following Curricula | | | | | |



| Course L0805: Embedde | ed Systems |
|-----------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Heiko Falk |
| Language | EN |
| Cycle | SoSe |
| Content | Introduction Specifications and Modeling Embedded/Cyber-Physical Systems Hardware System Software Evaluation and Validation Mapping of Applications to Execution Platforms Optimization |
| Literature | Peter Marwedel. Embedded System Design - Embedded Systems Foundations of Cyber- Physical Systems. 2nd Edition, Springer, 2012., Springer, 2012. |

| course L0806: Embedded Systems | | |
|--------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Heiko Falk | |
| Language | EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | |
|-----------------------------------|---|--|--|---|
| Title Numerical Mathematics I (Li | • | Typ Lecture | Hrs/wk | 3 |
| Numerical Mathematics I (Li | , | Recitation Section (s | mall) 2 | 3 |
| - | Prof. Sabine Le Borne | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | I II for Technomathematicians | | | |
| Educational Objectives | After taking part successfully, students have | reached the following lea | rning results | |
| Professional Competence | | | | |
| Knowledge | Students are able to name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root finding problems and to explain their core ideas, repeat convergence statements for the numerical methods, explain aspects for the practical execution of numerical methods with respect to computationa and storage complexitx. | | | |
| Skills | Students are able to implement, apply and compare numerical methods using MATLAB, justify the convergence behaviour of numerical methods with respect to the problem and solution algorithm, select and execute a suitable solution approach for a given problem. | | | |
| Personal Competence | | | | |
| Social Competence | work together in heterogeneously co and background knowledge), expla practical aspects regarding the imple | ain theoretical foundation | | |
| Autonomy | Students are capable to assess whether the supporting theoretical and practical excercises are better solved individually or in a team, to assess their individual progess and, if necessary, to ask questions and seek help. | | | |
| Workload in Hours | Independent Study Time 124, Study Time in | Lecture 56 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 90 minutes | | | |
| | General Engineering Science (German prog General Engineering Science (German p Biomechanics: Compulsory General Engineering Science (German p Materials in Engineering Sciences: Compuls General Engineering Science (German prog General Engineering Science (German p Compulsory | rogram): Specialisation rogram): Specialisation sory gram): Specialisation Biom | Mechanical E Mechanical E nedical Engine | ngineering, Focungineering, Focunering: Compulsor |

Focus Biomechanics: Compulsory



General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory Assignment for the Electrical Engineering: Core qualification: Elective Compulsory **Following Curricula** General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,

Computational Science and Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Process Engineering: Specialisation Process Engineering: Elective Compulsory

Course L0417: Numerical Mathematics I

Typ
Lecture
Hrs/wk
2

| Course Lot 17. Numerical Mathematics I | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Sabine Le Borne, Dr. Patricio Farrell | |
| Language | DE/EN | |
| Cycle | WiSe | |
| Content | Error analysis: Number representation, error types, conditioning and stability Interpolation: polynomial and spline interpolation Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, adaptive quadrature, difference formulas Linear systems: LU and Cholesky factorization, matrix norms, conditioning Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular value decomposition, regularization Eigenvalue problems: power iteration, inverse iteration, QR algorithm Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Quasi-Newton methods for systems | |
| Literature | Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik für Ingenieure und Naturwissenschaftler, Springer | |



| Course L0418: Numerical Mathematics I | |
|---------------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Sabine Le Borne, Dr. Patricio Farrell |
| Language | DE/EN |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M0793: Se | minars Computer Science and | Mathematics | | |
|--|--|-----------------------------|----------------|----------------|
| Caurage | | | | |
| Courses | | T | Hara tada | |
| Title Seminar Computational Mat | hematics/Computer Science (L0797) | Typ Seminar | Hrs/wk 2 | CP 2 |
| Seminar Computational Eng | | Seminar | 2 | 2 |
| Seminar Engineering Mathe | matics/Computer Science (L1781) | Seminar | 2 | 2 |
| Module Responsible | Prof. Karl-Heinz Zimmermann | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Basic knowledge in Computer Science, Mathematics, and eventually Engineering Science. | | | |
| Educational Objectives | After taking part successfully, students have | ve reached the following le | arning results | |
| Professional | | | | |
| Competence | | | | |
| Knowledge | The students know who to acquire basic knowledge in a rudimentary field of Computer Science Mathematics, or Engineering Science. | | | |
| Skills | The students are able to elaborate self-reliantly a rudimentary subfield of Computer Science, Mathematics, or Engineering Science. | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 | | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Presentation | | | |
| Examination duration and scale | Presentation 20 min and discussion 5 min | 1. | | |
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science Compulsory Computer Science: Core qualification: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science Compulsory Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory | | | |

| Course L0797: Seminar Computational Mathematics/Computer Science | | |
|--|--|--|
| Тур | Seminar | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Karl-Heinz Zimmermann, Dr. Jens-Peter Zemke | |
| Language | DE/EN | |
| Cycle | WiSe/SoSe | |
| Content | Seminar presentations by enrolled students. Seminar topics from the field of computer-oriented mathematics or computer science are proposed by the organizer Active participation in discussions. | |
| Literature | Wird vom Seminarveranstalter bekanntgegeben. | |



| Course L0796: Seminar | Computational Engineering Science | |
|-----------------------|--|--|
| Тур | Seminar | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Karl-Heinz Zimmermann | |
| Language | DE/EN | |
| Cycle | WiSe/SoSe | |
| Content | Seminar presentations by enrolled students. Seminar topics from the field of computer science or engineering science are proposed by the organizer Active participation in discussions. | |
| Literature | Wird vom Seminarveranstalter bekanntgegeben. | |

| Course L1781: Seminar Engineering Mathematics/Computer Science | | |
|--|--|--|
| Тур | Seminar | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Karl-Heinz Zimmermann, Dr. Jens-Peter Zemke | |
| Language | DE/EN | |
| Cycle | WiSe/SoSe | |
| Content | Seminar presentations by enrolled students. Seminar topics from the field of computer science or engineering mathematics are proposed by the organizer Active participation in discussions. | |
| Literature | Wird vom Seminarveranstalter bekanntgegeben. | |



| Module M0834: Co | omputernetworks and Inte | rnet Security | | |
|--|--|--|---------------|-------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Computer Networks and Int | , , | Lecture | 3 | 5 |
| Computer Networks and Int | ernet Security (L1099) | Recitation Section (small) | 1 | 1 |
| Module Responsible | Prof. Andreas Timm-Giel | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Basics of Computer Science | | | |
| Educational Objectives | After taking part successfully, stude | nts have reached the following learnin | g results | |
| Professional Competence | | | | |
| Knowledge | Students are able to explain important and common Internet protocols in detail and classify them, in order to be able to analyse and develop networked systems in further studies and job. | | | |
| Skills | Students are able to analyse common Internet protocols and evaluate the use of them in different domains. | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| | | arts out of high amount of professed it. | sional knowl | edge and ca |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | - | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 112() min | | | |
| Assignment for the Following Curricula | | | nputer Scienc | |

Technomathematics: Specialisation II. Informatics: Elective Compulsory



| urse L1098: Compute | r Networks and Internet Security |
|---------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 5 |
| Workload in Hours | Independent Study Time 108, Study Time in Lecture 42 |
| Lecturer | Prof. Andreas Timm-Giel, Prof. Dieter Gollmann |
| Language | EN |
| Cycle | WiSe |
| Content | In this class an introduction to computer networks with focus on the Internet and its security is given Basic functionality of complex protocols are introduced. Students learn to understand these and identify common principles. In the exercises these basic principles and an introduction to performance modelling are addressed using computing tasks and (virtual) labs. In the second part of the lecture an introduction to Internet security is given. This class comprises: Application layer protocols (HTTP, FTP, DNS) Transport layer protocols (TCP, UDP) Network Layer (Internet Protocol, routing in the Internet) Data link layer with media access at the example of Ethernet Multimedia applications in the Internet Network management Internet security: IPSec Internet security: Firewalls |
| Literature | Kurose, Ross, Computer Networking - A Top-Down Approach, 6th Edition, Addison-Wesley Kurose, Ross, Computernetzwerke - Der Top-Down-Ansatz, Pearson Studium; Auflage: 6 Auflage W. Stallings: Cryptography and Network Security: Principles and Practice, 6th edition Further literature is announced at the beginning of the lecture. |

| Course L1099: Computer Networks and Internet Security | |
|---|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Andreas Timm-Giel, Prof. Dieter Gollmann |
| Language | EN |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M0731: Fu | nctional Programming | | | |
|-----------------------------------|---|---------------------------------|----------------|--------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Functional Programming (L0 | 0624) | Lecture | 2 | 2 |
| Functional Programming (L0 | 0625) | Recitation Section (larg | e) 2 | 2 |
| Functional Programming (L0 | 0626) | Recitation Section (sma | all) 2 | 2 |
| Module Responsible | Prof. Sibylle Schupp | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Discrete mathematics at high-school lev | rel | | |
| Educational Objectives | After taking part successfully, students h | ave reached the following learn | ing results | |
| Professional Competence | | | | |
| Knowledge | Students apply the principles, constructs, and simple design techniques of functional programming. They demonstrate their ability to read Haskell programs and to explain Haskell syntax as well as Haskell's read-eval-print loop. They interpret warnings and find errors in programs. They apply the fundamental data structures, data types, and type constructors. They employ strategies for unit tests of functions and simple proof techniques for partial and total correctness. They distinguish laziness from other evaluation strategies. | | | |
| Skills | Students break a natural-language description down in parts amenable to a formal specification and develop a functional program in a structured way. They assess different language constructs, make conscious selections both at specification and implementations level, and justify their choice. They analyze given programs and rewrite them in a controlled way. They design and implement unit tests and can assess the quality of their tests. They argue for the correctness of their program. | | | |
| Personal Competence | | | | |
| Social Competence | Students practice peer programming wi peer. They defend their programs orally | | problems and s | colutions to their |
| Autonomy | In programming labs, students learn under supervision (a.k.a. "Betreutes Programmieren") the mechanics of programming. In exercises, they develop solutions individually and independently, and receive feedback. | | | |
| Workload in Hours | Independent Study Time 96, Study Time | e in Lecture 84 | | |
| Credit points | 6 | | | |
| Studienleistung | Compulsory Bonus Form Yes 15 % Excercises | Description | | |
| Examination | Written exam | | | |
| Examination duration and scale | 90 min | | | |
| | General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science Elective Compulsory Computer Science: Core qualification: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory | | | |



| ourse L0624: Functional Programming | | |
|-------------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Sibylle Schupp | |
| Language | EN | |
| Cycle | WiSe | |
| Content | Functions, Currying, Recursive Functions, Polymorphic Functions, Higher-Order Functions Conditional Expressions, Guarded Expressions, Pattern Matching, Lambda Expressions Types (simple, composite), Type Classes, Recursive Types, Algebraic Data Type Type Constructors: Tuples, Lists, Trees, Associative Lists (Dictionaries, Maps) Modules Interactive Programming Lazy Evaluation, Call-by-Value, Strictness Design Recipes Testing (axiom-based, invariant-based, against reference implementation) Reasoning about Programs (equation-based, inductive) Idioms of Functional Programming Haskell Syntax and Semantics | |
| Literature | Graham Hutton, Programming in Haskell, Cambridge University Press 2007. | |

| Course L0625: Function | al Programming |
|------------------------|---|
| | Recitation Section (large) |
| Hrs/wk | |
| CP | |
| | |
| | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Sibylle Schupp |
| Language | EN |
| Cycle | WiSe |
| Content | Functions, Currying, Recursive Functions, Polymorphic Functions, Higher-Order Functions Conditional Expressions, Guarded Expressions, Pattern Matching, Lambda Expressions Types (simple, composite), Type Classes, Recursive Types, Algebraic Data Type Type Constructors: Tuples, Lists, Trees, Associative Lists (Dictionaries, Maps) Modules Interactive Programming Lazy Evaluation, Call-by-Value, Strictness Design Recipes Testing (axiom-based, invariant-based, against reference implementation) Reasoning about Programs (equation-based, inductive) Idioms of Functional Programming Haskell Syntax and Semantics |
| Literature | Graham Hutton, Programming in Haskell, Cambridge University Press 2007. |



| Course L0626: Functional Programming | | |
|--------------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk 2 | 2 | |
| CP 2 | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Sibylle Schupp | |
| Language E | EN | |
| Cycle | WiSe | |
| Content | Functions, Currying, Recursive Functions, Polymorphic Functions, Higher-Order Functions Conditional Expressions, Guarded Expressions, Pattern Matching, Lambda Expressions Types (simple, composite), Type Classes, Recursive Types, Algebraic Data Type Type Constructors: Tuples, Lists, Trees, Associative Lists (Dictionaries, Maps) Modules Interactive Programming Lazy Evaluation, Call-by-Value, Strictness Design Recipes Testing (axiom-based, invariant-based, against reference implementation) Reasoning about Programs (equation-based, inductive) Idioms of Functional Programming Haskell Syntax and Semantics | |
| Literature (| Graham Hutton, Programming in Haskell, Cambridge University Press 2007. | |



| Module M0791: Co | omputer Architectu | ure | | | |
|--|--|---|------------------------------------|---------------|-------------|
| Courses | | | | | |
| Title Computer Architecture (L07 | 93) | | Typ Lecture | Hrs/wk | CP 3 |
| Computer Architecture (L07 | 94) | | Project-/problem-based Learning | 2 | 2 |
| Computer Architecture (L18 | 64) | | Recitation Section (small) | 1 | 1 |
| Module Responsible | | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | Module "Computer Engi | neering" | | | |
| Educational Objectives | After taking part success | sfully, students have reach | ed the following learning | results | |
| Professional Competence | | | | | |
| Knowledge | This module presents advanced concepts from the discipline of computer architecture. In the beginning, a broad overview over various programming models is given, both for general-purpose computers and for special-purpose machines (e.g., signal processors). Next, foundational aspects of the micro-architecture of processors are covered. Here, the focus particularly lies on the so-called pipelining and the methods used for the acceleration of instruction execution used in this context. The students get to know concepts for dynamic scheduling, branch prediction, superscalar execution of machine instructions and for memory hierarchies. | | | | |
| Skills | The students are able to describe the organization of processors. They know the different architectural principles and programming models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g., performance or energy efficiency. They evaluate different structures of memory hierarchies, know parallel computer architectures and are able to distinguish between instruction- and data-level parallelism. | | | | |
| Personal Competence | | | | | |
| Social Competence | Children are able to achie similar machines along arising grants and to proper the good to account the | | | | |
| Autonomy | Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. | | | | |
| Workload in Hours | Independent Study Time | e 110, Study Time in Lectu | re 70 | | |
| Credit points | 6 | | | | |
| Studienleistung | No 15 % | Form Subject theoretical practical work | Description and | | |
| Examination | Written exam | | | | |
| Examination duration and scale | | course and 4 attestations f | rom the PBL "Computer a | architecture' | , |
| Assignment for the Following Curricula | denotal Engineering colonies (English program), openialisation compater colonies. Compaisory | | | | |



| Course L0793: Compute | er Architecture |
|-----------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Heiko Falk |
| Language | DE/EN |
| Cycle | WiSe |
| Content | Introduction VHDL Basics Programming Models Realization of Elementary Data Types Dynamic Scheduling Branch Prediction Superscalar Machines Memory Hierarchies The theoretical tutorials amplify the lecture's content by solving and discussing exercise sheets and thus serve as exam preparation. Practical aspects of computer architecture are taught in the FPGA-based PBL on computer architecture whose attendance is mandatory. |
| Literature | D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. |

| Course L0794: Computer Architecture | | |
|-------------------------------------|---|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE/EN | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L1864: Computer Architecture | | |
|-------------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE/EN | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | | | |
|--|--|--------------------------|----------------------------------|---------|-------------|-----------------|
| | | | Тур | | Hrs/wk | СР |
| ntroduction to Control Systentroduction to Control Syste | | | Lecture Recitation Section (s | mall) | 2 2 | 4 2 |
| Module Responsible | Prof. Herbert We | rner | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous Knowledge | Representation of | of signals and systems | in time and frequency domain, | Lapla | ce transfor | m |
| Educational Objectives | After taking part | successfully, students I | nave reached the following lea | rning r | esults | |
| Professional Competence | | | | | | |
| Knowledge | Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequency response They can explain issues arising when controllers designed in continuous time domain are implemented digitally | | | | | |
| Skills | Students can transform models of linear dynamic systems from time to frequency domain and vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks | | | | | |
| Personal Competence | | | | | | |
| Social Competence | | | jointly solve technical proble | ms, ar | nd experim | entally validat |
| Autonomy | their controller designs Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress. | | | | | |
| Workload in Hours | Independent Stu | dy Time 124, Study Tir | ne in Lecture 56 | | | |
| Credit points | | a, imio 124, otudy III | | | | |
| Studienleistung | | | | | | |
| | Written exam | | | | | |
| Examination duration and scale | | | | | | |



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

General Engineering Science (English program): Core qualification: Compulsory

Assignment for the General Englowing Curricula Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory



Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective

Compulsory

Process Engineering: Core qualification: Compulsory

| | ion to Control Systems | | | |
|------------|--|--|--|--|
| | Lecture | | | |
| Hrs/wk | | | | |
| СР | 4 | | | |
| | Independent Study Time 92, Study Time in Lecture 28 | | | |
| | Prof. Herbert Werner | | | |
| Language | | | | |
| Cycle | | | | |
| Content | Signals and systems Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle Root locus techniques Root locus design of PID controllers Frequency response techniques Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Time delay systems Root locus and frequency response of time delay systems Smith predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course | | | |
| Literature | Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic System Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, I 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010 | | | |



| Course L0655: Introduction to Control Systems | |
|---|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Herbert Werner |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M0562: Co | omputability and Complexity The | ory | | |
|---|---|--|------------------|---------------------|
| Courses | | | | |
| Title Computability and Complexi Computability and Complexi | | Typ Lecture Recitation Section (small) | Hrs/wk 2 2 | CP 3 3 |
| | Prof. Karl-Heinz Zimmermann | , , | | |
| Admission Requirements | | | | |
| Recommended Previous Knowledge | Discrete Algebraic Structures, Automata Theo | ory, Logic, and Formal Langua | ge Theory. | |
| Educational Objectives | After taking part successfully, students have r | eached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The students known the important machine models of computability, the class of partial recursive functions, universal computability, Gödel numbering of computations, the theorems of Kleene, Rice, and Rice-Shapiro, the concept of decidable and undecidable sets, the word problems for semi-Thue systems, Thue systems, semi-groups, and Post correspondence systems, Hilbert's 10-th problem, and the basic concepts of complexity theory. | | | |
| Skills | Students are able to investigate the computability of sets and functions and to analyze the complexity of computable functions. | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | Students are able to acquire new knowledge from newer literature and to associate the acquired knowledge with other classes. | | | |
| Workload in Hours | Independent Study Time 124, Study Time in I | _ecture 56 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | | | | |
| Examination duration and scale | 20 min | | | |
| Assignment for the Following Curricula | General Engineering Science (German pro Elective Compulsory Computer Science: Core qualification: Comp General Engineering Science (English pro Elective Compulsory Computational Science and Engineering: Sp Computational Science and Engineering: Sp Technomathematics: Specialisation II. Inform | ulsory ogram, 7 semester): Speciali ecialisation Computer Science ecialisation Computer Science atics: Elective Compulsory | sation Com | puter Science: |

| Course L0166: Computability and Complexity Theory | | |
|---|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Karl-Heinz Zimmermann | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | | |
| Literature | | |

Technomathematics: Core qualification: Elective Compulsory



| Course L0167: Computability and Complexity Theory | | |
|---|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Karl-Heinz Zimmermann | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | | |
| Literature | | |



| Module M0829: Fo | oundations of Management | | | |
|--|---|---|--------------|----------------|
| - | v | | | |
| Courses | | Tun | Hrs/wk | СР |
| Title Management Tutorial (L0882) Introduction to Management (L0880) | | Typ Recitation Section (large) Lecture | 2 3 | 3 3 |
| Module Responsible | Prof. Christoph Ihl | | | |
| Admission Requirements | INone | | | |
| Recommended Previous Knowledge | I Racic k nowiedde of Wathematice and Rijein | ess | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | |
| Professional Competence | | important basics of many diffo | ront aroas i | n Business and |
| Knowledge | Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects describe and explain basic business functions as production, procurement and sourcing supply chain management, organization and human ressource management, information management, innovation management and marketing explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance state basics from accounting and costing and selected controlling methods. | | | |
| Skills | Students are able to analyse business units with respect to different criteria (organization, objectives strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to • analyse Management goals and structure them appropriately • analyse organisational and staff structures of companies • apply methods for decision making under multiple objectives, under uncertainty and under risk • analyse production and procurement systems and Business information systems • analyse and apply basic methods of marketing • select and apply basic methods from mathematical finance to predefined problems • apply basic methods from accounting, costing and controlling to predefined problems | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a coherent | | | |
| Autonomy | Students are able to work in a team and to organize the team themselves to write a report on their project. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in | Lecture 70 | | |
| Credit points | <u> </u> | | | |
| Studienleistung | None | | | |
| Examination | Subject theoretical and practical work | | | |
| Evamination duration | <u> </u> | | | |

Examination duration



and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

Assignment for the Following Curricula

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:



Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

| Course L0882: Management Tutorial | | | | |
|-----------------------------------|--|--|--|--|
| Тур | Recitation Section (large) | | | |
| Hrs/wk | 2 | | | |
| СР | 3 | | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | | |
| Lecturer | Prof. Christoph Ihl, Katharina Roedelius, Tobias VIcek | | | |
| Language | DE | | | |
| Cycle | WiSe/SoSe | | | |
| Content | In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools. If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on self-selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the business knowledge from the lecture should come to practical use. The group projects are guided by a mentor. | | | |
| Literature | Relevante Literatur aus der korrespondierenden Vorlesung. | | | |



| rse Lu880: Introduct | ion to Management | | | | |
|----------------------|---|--|--|--|--|
| Тур | Lecture | | | | |
| Hrs/wk | 3 | | | | |
| СР | 3 | | | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | | | |
| Lecturer | Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona | | | | |
| Language | DE | | | | |
| Cycle | WiSe/SoSe | | | | |
| Content | Introduction to Business and Management, Business versus Economics, relevant areas i Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chai Management, Information Management Definitions as information, information systems, aspects of data security and strategi information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects | | | | |
| Literature | Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgar 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006. | | | | |



| Module M1269: La | b Cyber-Physical Systems | | | |
|--|---|------------------------------------|--------------|---|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Lab Cyber-Physical Systems (L1740) | | Project-/problem-based Learning | 4 | 6 |
| Module Responsible | Prof. Heiko Falk | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have rea | ached the following learning | results | |
| Professional Competence | | | | |
| | Cyber-Physical Systems (CPS) are tightly integrated with their surrounding environment, via sens A/D and D/A converters, and actors. Due to their particular application areas, highly special sensors, processors and actors are common. Accordingly, there is a large variety of different specification approaches for CPS - in contrast to classical software engineering approaches. | | | |
| Knowledge | Based on practical experiments using robot kits and computers, the basics of specification an modelling of CPS are taught. The lab introduces into the area (basic notions, characteristical properties) and their specification techniques (models of computation, hierarchical automata, data flow models, petri nets, imperative approaches). Since CPS frequently perform control tasks, the lab experiments will base on simple control applications. The experiments will use state-of-the-a industrial specification tools (MATLAB/Simulink, LabVIEW, NXC) in order to model cyber-physical models that interact with the environment via sensors and actors. | | | characteristical omata, data flow tasks, the lab's state-of-the-ar |
| Skills | After successful attendance of the lab, students are able to develop simple CPS. They understand the interdependencies between a CPS and its surrounding processes which stem from the fact that a CPS interacts with the environment via sensors, A/D converters, digital processors, D/A converters and actors. The lab enables students to compare modelling approaches, to evaluate their advantages and limitations, and to decide which technique to use for a concrete task. They will be able to apply these techniques to practical problems. They obtain first experiences in hardware-related software development, in industry-relevant specification tools and in the area of simple control applications. | | | |
| Personal Competence | ; | | | |
| Social Competence | Students are able to solve similar problems alo | ne or in a group and to pres | ent the resu | Its accordingly. |
| Autonomy | Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Le | ecture 56 | | |
| Credit points | 6 | | | |
| Studienleistung | | | | |
| Examination | Written elaboration | | | |
| Examination duration and scale | Execution and documentation of all lab experin | nents | | |
| Assignment for the Following Curricula | | | | |



| Course L1740: Lab Cyber-Physical Systems | | | | |
|--|--|--|--|--|
| Тур | Project-/problem-based Learning | | | |
| Hrs/wk | 4 | | | |
| СР | 6 | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Lecturer | Prof. Heiko Falk | | | |
| Language | DE/EN | | | |
| Cycle | SoSe | | | |
| Content | Experiment 1: Programming in NXC Experiment 2: Programming the Robot in Matlab/Simulink Experiment 3: Programming the Robot in LabVIEW | | | |
| Literature | Peter Marwedel. Embedded System Design - Embedded System Foundations of Cyber-Physical Systems. 2nd Edition, Springer, 2012. Begleitende Foliensätze | | | |



| Modulo M0722, Co | thuoro Enginoerin | | | | |
|---|--|---|---|---------------|-----------------|
| Module M0732: So | ntware Engineerin | g | | | |
| Courses | | | | | |
| Title | | | Тур | Hrs/wk | СР |
| Software Engineering (L0627) | | | Lecture | 2 | 3 |
| Software Engineering (L0628) Recitation Section (small) 2 | | | 3 | | |
| Module Responsible | Prof. Sibylle Schupp | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | Procedural programmer | ramming or Funct | ages ional programming orithms, and data structures | | |
| Educational Objectives | After taking part success | sfully, students ha | ve reached the following learning | g results | |
| Professional Competence | | | | | |
| Knowledge | Students explain the phases of the software life cycle, describe the fundamental terminology and concepts of software engineering, and paraphrase the principles of structured software development. They give examples of software-engineering tasks of existing large-scale systems. They write test cases for different test strategies and devise specifications or models using different notations, and critique both. They explain simple design patterns and the major activities in requirements analysis, maintenance, and project planning. | | | | |
| Skills | For a given task in the software life cycle, students identify the corresponding phase and select an appropriate method. They choose the proper approach for quality assurance. They design tests for realistic systems, assess the quality of the tests, and find errors at different levels. They apply and modify non-executable artifacts. They integrate components based on interface specifications. | | | | |
| Personal Competence | | | | | |
| Social Competence | Students practice peer communicate in English | | They explain problems and so | lutions to th | neir peer. They |
| Autonomy | Using on-line quizzes and accompanying material for self study, students can assess their level of knowledge continuously and adjust it appropriately. Working on exercise problems, they receive additional feedback. | | | | |
| Workload in Hours | Independent Study Time | e 124, Study Time | in Lecture 56 | | |
| Credit points | 6 | | | | |
| Ctudioniciatura | Compulsory Bonus | Form | Description | | |
| Studienleistung | Yes 15 % | Excercises | | | |
| Examination | Written exam | | | | |
| Examination duration and scale | 90 min | | | | |
| Assignment for the Following Curricula | Elective Compulsory Computer Science: Core General Engineering S Elective Compulsory Computational Science Computational Science | e qualification: Co Science (English and Engineering: and Engineering: | program, 7 semester): Special mpulsory program, 7 semester): Special Specialisation Computer Science Specialisation Computer Science or matics: Elective Compulsory | lisation Con | nputer Science: |



| Typ | Lecture |
|------------|---|
| Hrs/wk | |
| СР | |
| | Independent Study Time 62, Study Time in Lecture 28 |
| | Prof. Sibylle Schupp |
| Language | EN |
| Cycle | SoSe |
| Content | Software Life Cycle Models (Waterfall, V-Model, Evolutionary Models, IncrementalModels, Iterative Models, Agile Processes) Requirements (Elicitation Techniques, UML Use Case Diagrams, Functional and Non-Functional Requirements) Specification (Finite State Machines, Extended FSMs, Petri Nets, Behavioral UML Diagrams, Data Modeling) Design (Design Concepts, Modules, (Agile) Design Principles) Object-Oriented Analysis and Design (Object Identification, UML Interaction Diagrams, UML Class Diagrams, Architectural Patterns) Testing (Blackbox Testing, Whitebox Testing, Control-Flow Testing, Data-Flow Testing, Testing in the Large) Maintenance and Evolution (Regression Testing, Reverse Engineering, Reengineering) Project Management (Blackbox Estimation Techniques, Whitebox Estimation Techniques, Project Plans, Gantt Charts, PERT Charts) |
| Literature | Kassem A. Saleh, Software Engineering, J. Ross Publishing 2009. |

| Course L0628: Software Engineering | | | |
|------------------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Sibylle Schupp | | |
| Language | EN | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |



| Module M0971: Op | erating Systems | | | | | |
|-----------------------------------|--|---|--|--|--|--|
| Courses | | | | | | |
| Title | | Тур | Hrs/wk | СР | | |
| Operating Systems (L1153) | | Lecture | 2 | 3 | | |
| Operating Systems (L1154) | Recitation Section (small) 2 3 | | | | | |
| Module Responsible | Prof. Volker Turau | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous Knowledge | Object-oriented programming, algorithms, and data structures Procedural programming Experience in using tools related to operating systems such as editors, linkers, compilers Experience in using C-libraries | | | | | |
| Educational Objectives | After taking part successfully, students ha | ave reached the following learning | results | | | |
| Professional Competence | | | | | | |
| Knowledge | Students explain the main abstractions process, virtual memory, deadlock, lifelock, and file of operations systems, describe the process states and their transitions, and paraphrase the architectural variants of operating systems. They give examples of existing operating systems and explain their architectures. The participants of the course write concurrent programs using threads, conditional variables and semaphores. Students can describe the variants of realizing a file system. Students explain at least three different scheduling algorithms. | | | | | |
| Skills | Students are able to use the POSIX libraries for concurrent programming in a correct and efficient way. They are able to judge the efficiency of a scheduling algorithm for a given scheduling task in a given environment. | | | | | |
| Personal Competence | | | | | | |
| Social Competence | | | | | | |
| Autonomy | | | | | | |
| Workload in Hours | Independent Study Time 124, Study Time | e in Lecture 56 | | | | |
| Credit points | 6 | | | | | |
| Studienleistung | None | | | | | |
| Examination | Written exam | | | | | |
| Examination duration and scale | 90 min | | | | | |
| | General Engineering Science (German page General Engineering Science (German Elective Compulsory Computer Science: Core qualification: Computer Science: Core qualification: Computer Engineering Science (English page) General Engineering Science (English Elective Compulsory Computational Science and Engineering Computational Science and Engineering Technomathematics: Specialisation II. In | ompulsory rogram, 7 semester): Special ompulsory rogram): Specialisation Computer of program, 7 semester): Speciali g: Specialisation Computer Science g: Specialisation Computer Science | Science: Consation Conset Science: Conset Scie | mpulsory mputer Science: mputer Science: ompulsory | | |



| Course L1153: Operating | g Systems |
|-------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Volker Turau |
| Language | DE |
| Cycle | SoSe |
| Content | Architectures for Operating Systems Processes Concurrency Deadlocks Memory organization Scheduling File systems |
| Literature | Operating Systems, William Stallings, Pearson International Edition Moderne Betriebssysteme, Andrew Tanenbaum, Pearson Studium |

| Course L1154: Operating Systems | |
|---------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Volker Turau |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | | | |
|--|---|--|--|---|---|--|
| Title | | | Тур | | Hrs/wk | СР |
| Mathematical Statistics (L13 Mathematical Statistics (L13 | • | | Lecture Recitat | e tion Section (small) | 3 1 | 4 2 |
| Module Responsible | Prof. Natalie N | leumeyer | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous Knowledge | Mathematical Measure The | Stochastics ory and Stochastics | 3 | | | |
| Educational Objectives | | | | following learning | results | |
| Professional Competence | | • | | 0 0 | | |
| Knowledge | Maxim optima applica domai Studer illustra | um-Likelihood me al tests for parame ation to estimation ns and test families nts can discuss lo ting these connect | asic concepts in Mathen thods for construction of tric probability distribution and test problems, to They are able to explain gical connections between with the help of examples and can reproduce the | of estimators, options, sufficiency a ests in normal d n them using appreen these conce mples. | imal unfals nd complet istribution opriate exa | ified estimator teness and the and confidenc mples. |
| Skills | in this Studen studien For a g | course. Moreover, nts are able to dis d in the course. | olems in Mathematical S they are capable of solvi scover and verify further students can develop ar esults. | ng them by applyi r logical connecti | ng establish ons betwee | ned methods. en the concep |
| Personal Competence | | | | | | |
| Social Competence | comme • In doir | on language. ng so, they can cor rs. Moreover, they | ork together in teams. In municate new concepts can design examples to | s according to the | needs of the | heir cooperatir |
| Autonomy | can sp • Studer | ecify open questio | checking their understan ns precisely and know w d sufficient persistence to problems. | here to get help in | solving the | em. |
| Workload in Hours | Independent | Study Time 124, St | udy Time in Lecture 56 | | | |
| Credit points | | <u> </u> | | | | |
| Studienleistung | | | | | | |
| Examination | Written exam | | | | | |
| Examination duration | 120 minutes | | | | | |



| | Elective Compulsory |
|---------------------|---|
| Assignment for the | Computer Science: Specialisation Computational Mathematics: Elective Compulsory |
| Following Curricula | General Engineering Science (English program, 7 semester): Specialisation Computer Science: |
| | Elective Compulsory |
| | Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory |
| | Technomathematics: Specialisation I Mathematics: Flective Compulsory |

| Course L1339: Mathema | atical Statistics |
|-----------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH |
| Language | DE/EN |
| Cycle | SoSe |
| Content | Substitution and Maximum-Likelihood methods for construction of estimators Optimal unfalsified estimators Optimal tests for parametric probability distributions (Neymann-Pearson theory) Sufficiency and completeness and their application to estimation and test problems Tests in normal distribution (e.g. Student's test) Confidence domains and test families |
| Literature | V. K. Rohatgi and A. K. Ehsanes Saleh (2001). An introduction to probability and statistics. Wiley. L. Wasserman (2010). All of statistics: A concise course in statistical inference. Springer. H. Witting (1985). Mathematische Statistik: Parametrische Verfahren bei festem Stichprobenumfang. Teubner. |

| ourse L1340: Mathematical Statistics | |
|--------------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH |
| Language | DE/EN |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



Specialization Mechanical Engineering

The educational goal of this Bachelor's program is to develop the skills to select and link fundamental methods and procedures in order to solve technical problems in the field of General Engineering science, especially in the selected subject area of specialisation.

Graduates have:

- 1) Sound knowledge in the subject areas mathematics, thermodynamics, mechanics, electrical Engineering and computer science.
- 2) A basic knowledge in the field of measurement and control engineering, fluid mechanics and materials science.
- 3) In-depth knowledge in Engineering applications, especially in the selected subject area of specialisation (product development and manufacturing, material science, aircrafts, energy Engineering, mechatronics, medical engineering, theoretical mechanical engineering). They have in particular the necessary methodological knowledge and its application to engineering problems, taking into account technical specifications and economic and social parameters.
- 4) The ability to work scientifically and to expand their specialized knowledge independently.

Graduates are able to work responsibly and competently as mechanical engineers, especially in occupations related to the selected subject area of specialisation.

| Courses | | | | | |
|-----------------------------------|--|---|------------------------------------|---------------|----------------|
| Title | | | Тур | Hrs/wk | CP |
| Embodiment Design and 3D |)-CAD (L | L0268) | Lecture | 2 | 1 |
| Mechanical Design Project | I (L0695 | 5) | Project-/problem-based Learning | 3 | 2 |
| Mechanical Design Project | II (L0592 | 2) | Project-/problem-based Learning | 3 | 2 |
| Team Project Design Metho | odology (| (L0267) | Project-/problem-based Learning | 2 | 1 |
| Module Responsible | Prof. D | Dieter Krause | | | |
| Admissior Requirements | None | | | | |
| Recommended Previous Knowledge | • | Fundamentals of Mechanical En Mechanics Fundamentals of Materials Scien Production Engineering | | | |
| Educational Objectives | After to | After taking part successfully, students have reached the following learning results | | | |
| Professiona Competence | | | | | |
| Knowledge | • | explain design guidelines for m manufacturing requirements, describe basics of 3D CAD, explain basics methods of engin | nachinery parts e.g. considering l | oad situation | , materials ar |
| Skills | After passing the module, students are able to: independently create sketches, technical drawings and documentations e.g. using 3D CAD, design components based on design guidelines autonomously, dimension (calculate) used components, use methods to design and solve engineering design tasks systamtically and solution-oriented, apply creativity techniques in teams. | | | | |
| | • | apply ordainly toominguoum too | u113. | | |



| Social Competence | develop and evaluate solutions in groups including making and documenting decisions, moderate the use of scientific methods, present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course. |
|---|---|
| Autonomy | Students are able to estimate their level of knowledge using activating methods within the lectures (e.g. with clickers), To solve engineering design tasks systematically. |
| Workload in Hours | Independent Study Time 40, Study Time in Lecture 140 |
| Credit points | 6 |
| Studienleistung | Compulsory BonusFormDescriptionYesNoneWritten elaborationYesNoneWritten elaborationYesNoneWritten elaborationYesNoneWritten elaboration |
| Examination | Written exam |
| Examination duration and scale | L180 |
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory |



| ourse L0268: Embodim | nent Design and 3D-CAD |
|----------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause |
| Language | DE |
| Cycle | WiSe |
| Content | Basics of 3D CAD technology Practical course to apply a 3D CAD system Introduction to the system Sketching and creation of components Creation of assemblies Deriving technical drawings |
| Literature | CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K.; Springer-Verlag, aktuelle Auflage. Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage. Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H; Hesser, W; Cornelsen, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. |



| Course L0695: Mechanic | cal Design Project I |
|------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 3 |
| СР | 2 |
| Workload in Hours | Independent Study Time 18, Study Time in Lecture 42 |
| Lecturer | Prof. Thorsten Schüppstuhl |
| Language | DE |
| Cycle | WiSe |
| Content | Create a technical documentation of an existing mechanical model Consolidation of the following aspects of technical drawings: Presentation of technical objects and standardized parts (bearings, seals, shaft-hub joints, detachable connections, springs, axes and shafts) Sectional views Dimensioning Tolerances and surface specifications Creating a tally sheet |
| Literature | Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011. Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008. Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005. |

| Course L0592: Mechanical Design Project II | | |
|--|---|--|
| Course Lossz. Mechanic | cai besign Project ii | |
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 3 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 18, Study Time in Lecture 42 | |
| Lecturer | Prof. Wolfgang Hintze | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Generation of sketches for functions and sub-functions Approximately calculation of shafts Dimension of bearings, screw connections and weld Generation of engineering drawings (assembly drawings, manufacturing drawing) | |
| Literature | Dubbel, Taschenbuch für Maschinenbau, Beitz, W., Küttner, KH, Springer-Verlag. Maschinenelemente, Band I - III, Niemann, G., Springer-Verlag. Maschinen- und Konstruktionselemente, Steinhilper, W., Röper, R., Springer-Verlag. Einführung in die DIN-Normen, Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G., Beitz, W., Springer-Verlag. | |



| Course L0267: Team Pro | oject Design Methodology |
|------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 2 |
| СР | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause |
| Language | DE |
| Cycle | SoSe |
| Content | Introduction to engineering designing methodology Team Project Design Methodology Creating requirement lists Problem formulation Creating functional structures Finding solutions Evaluation of the found concepts Documentation of the taken methodological steps and the concepts using presentation slides |
| Literature | Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen |



| Module M0933: Fu | ndamentals of Materials Science | | | |
|---|--|---|---|---|
| Courses | | | | |
| Title Fundamentals of Materials Fundamentals of Materials | Science I (L1085) Science II (Advanced Ceramic Materials, Polymers | Typ Lecture | Hrs/wk 2 | CP 2 |
| Composites) (L0506) | cs of Materials Science (L1095) | Lecture Lecture | 2 | 2 |
| | Prof. Jörg Weißmüller | | | |
| Admission Requirements | | | | |
| Recommended Previous Knowledge | | ematics | | |
| Educational Objectives | After taking part successfully, students have re | ached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The students have acquired a fundamental k describe this knowledge comprehensively. issues of atomic structure, microstructure, p mechanical properties. The students know a materials and can identify relevant approache trace materials phenomena back to the underly | Fundamental knowledge he hase diagrams, phase tran about the key aspects of cles for characterizing specific | ere means sformations, naracterization properties. T | specifically the corrosion and on methods for hey are able to |
| Skills | The students are able to trace materials phe laws of nature. Materials phenomena here re and stiffness, chemical properties such as cor solidification, precipitation, or melting. The conditions and the materials microstructure, a the material's behavior. | fers to mechanical propertie rosion resistance, and to pha students can explain the re | s such as st ase transforr elation betwe | rength, ductility nations such a een processin |
| Dava anal Campatanaa | | | | |
| Personal Competence Social Competence | | | | |
| Autonomy | | | | |
| | I Independent Study Time 96, Study Time in Lea | cture 84 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 180 min | | | |
| | General Engineering Science (German Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German progration General Engineering Science (German German German Engineering Science (German German Ge | program): Specialisation m): Specialisation Biomedic m): Specialisation Naval Arc m, 7 semester): Specialisation m, 7 semester): Specialisation gram, 7 semester): Specialisation | Mechanica al Engineeri chitecture: Co on Mechanic on Biomedic | I Engineering ng: Compulsor ompulsory cal Engineering cal Engineering al Architecture |
| | ı | | | |



| | Enviromental Engineering: Compulsory |
|---------------------|--|
| | Energy and Environmental Engineering: Core qualification: Compulsory |
| | General Engineering Science (English program): Specialisation Energy and Environmental |
| Following Curricula | Engineering: Compulsory |
| _ | General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory |
| | General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory |
| | General Engineering Science (English program): Specialisation Naval Architecture: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental |
| | Engineering: Compulsory |
| | Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory |
| | Mechanical Engineering: Core qualification: Compulsory |
| | Mechatronics: Core qualification: Compulsory |
| | Naval Architecture: Core qualification: Compulsory |
| | Technomathematics: Specialisation III. Engineering Science: Elective Compulsory |

| Course L1085: Fundamentals of Materials Science I | | |
|---|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Jörg Weißmüller | |
| Language | DE | |
| Cycle | WiSe | |
| Content | | |
| Literature | Vorlesungsskript W.D. Callister: Materials Science and Engineering - An Introduction. 5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7 | |

| Course L0506: Fundame | entals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) |
|-----------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Bodo Fiedler, Prof. Gerold Schneider |
| Language | DE |
| Cycle | SoSe |
| Content | Chemische Bindungen und Aufbau von Festkörpern; Kristallaufbau; Werkstoffprüfung; Schweißbarkeit; Herstellung von Keramiken; Aufbau und Eigenschaften der Keramik; Herstellung, Aufbau und Eigenschaften von Gläsern; Polymerwerkstoffe, Makromolekularer Aufbau; Struktur und Eigenschaften der Polymere; Polymerverarbeitung; Verbundwerkstoffe |
| Literature | Vorlesungsskript W.D. Callister: Materials Science and Engineering -An Introduction-5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7 |



| Course L1095: Physical | and Chemical Basics of Materials Science |
|------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Stefan Müller |
| Language | DE |
| Cycle | WiSe |
| Content | Motivation: "Atoms in Mechanical Engineering?" Basics: Force and Energy The electromagnetic Interaction "Detour": Mathematics (complex e-funktion etc.) The atom: Bohr's model of the atom Chemical bounds The multi part problem: Solutions and strategies Descriptions of using statistical thermodynamics Elastic theory of atoms Consequences of atomar properties on makroskopic Properties: Discussion of examples (metals, semiconductors, hybrid systems) |
| Literature | Für den Elektromagnetismus: Bergmann-Schäfer: "Lehrbuch der Experimentalphysik", Band 2: "Elektromagnetismus", de Gruyter Für die Atomphysik: Haken, Wolf: "Atom- und Quantenphysik", Springer Für die Materialphysik und Elastizität: Hornbogen, Warlimont: "Metallkunde", Springer |



| Courses | | | | |
|--|---|--|--------------|------------------|
| Title | 1 | Гур | Hrs/wk | СР |
| Fluid Mechanics (L0454) Fluid Mechanics (L0455) | | ecture Recitation Section (large) | 3 2 | 4 2 |
| Module Responsible | Prof. Thomas Rung | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Sound knowledge of engineering mathematics, eng | ineering mechanics and | thermodyn | amics. |
| Educational Objectives | After taking part successfully, students have reached | d the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Students will have the required sound knowledge to and physics of fluids. Students can scientifical mathematical models and are familiar with methods fluid engineering devices. | ly outline the rationa | le of flow | physics using |
| Skills | Students are able to apply fluid-engineering princ technical systems. The lecture enables the student for the fluid dynamic design of engineering devices | to carry out all necess | | |
| Personal Competence | | | | |
| Social Competence | The students are able to discuss problems and joint | ly develop solution strat | egies. | |
| Autonomy | The students are able to develop solution strategies analyse results. | s for complex problems | self-consist | ent and crticall |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture | ÷ 70 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 180 min | | | |
| General Engineering Science (German program): Specialisation Mechanical Engine Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Comp General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engine Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engine Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architectomy General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engine Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engine Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engine Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engine Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compul Mechanical Engineering: Core qualification: Compulsory | | ng: Compulsory al Engineering al Architecture ng: Compulsory g: Compulsory mpulsory al Engineering | | |



Naval Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

| Course L0454: Fluid Med | chanics |
|-------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Thomas Rung |
| Language | DE |
| Cycle | SoSe |
| Content | Overview Physical/mathematical modelling Special phenomena Basic equations of fluid dynamics The turbulence problem One dimensional theory for inkompressibel flows One dimensional theory for kompressibel flows Flow over contours without friction Flow over contours with friction Flow through channels Simplified equations for three dimensional flow Special aspects of the numerical solution for complex flows |
| Literature | Herwig, H.: Strömungsmechanik, 2. Auflage, Springer- Verlag, Berlin, Heidelberg, 2006 Herwig, H.: Strömungsmechanik von A-Z, Vieweg Verlag, Wiesbaden, 2004 |

| Course L0455: Fluid Mechanics | |
|-------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Thomas Rung |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Ш | Module M0960: Mechanics IV Systems) | (Kinetics II, | Oscillations, | Analytical | Mechanics, | Multibody |
|---|-------------------------------------|---------------|---------------|------------|------------|-----------|
| ľ | Courses | | | | | |

| Oddises | | |
|--|--------|----|
| Title Typ | Hrs/wk | СР |
| Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) Lecture (L1137) | 3 | 3 |
| Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) Recitation Section (small) (L1138) | 2 | 2 |
| Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) Recitation Section (large) (L1139) | 1 | 1 |
| Module Responsible Prof. Robert Seifried | | |
| Admission | | |

| (L1138) | Rectiation Section (Small) 2 2 |
|---------------------------------------|--|
| Mechanics IV (Kinetics II, (L1139) | Oscillations, Analytical Mechanics, Multibody Systems) Recitation Section (large) 1 1 |
| Module Responsible | Prof. Robert Seifried |
| Admission Requirements | INONG |
| Recommended Previous Knowledge | Mathematics I-III and Mechanics I-III |
| Educational Objectives | After taking part successfully, students have reached the following learning results |
| Professional Competence | |
| Knowledge | The students can describe the axiomatic procedure used in mechanical contexts; explain important steps in model design; present technical knowledge. |
| Skills | explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems; apply basic methods to engineering problems; estimate the reach and boundaries of the methods and extend them to be applicable to wider problem sets. |
| Personal Competence Social Competence | |
| Autonomy | Students are capable of determining their own strengths and weaknesses and to organize their time and learning based on those. |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 |
| Credit points | 6 |
| Studienleistung | Compulsory BonusFormDescriptionNo20 %MidtermWird nur im SoSe angeboten |
| Examination | Written exam |
| Examination duration and scale | 120 min |
| | General Engineering Science (German program): Specialization Mechanical Engineering |

General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory



| A a a i www a mt faw tha | Consul Famina aring Crianas (Familiah myanyam), Chanieliastian Naval Architecture, Compulsory |
|--------------------------|---|
| | General Engineering Science (English program): Specialisation Naval Architecture: Compulsory |
| Following Curricula | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: |
| | Compulsory |
| | Mechanical Engineering: Core qualification: Compulsory |
| | Mechatronics: Core qualification: Compulsory |
| | Naval Architecture: Core qualification: Compulsory |
| | Technomathematics: Specialisation III. Engineering Science: Elective Compulsory |
| | Technomathematics: Core qualification: Elective Compulsory |
| | Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective |
| | Compulsory |

| Course L1137: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) | |
|---|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Prof. Robert Seifried |
| Language | DE |
| Cycle | SoSe |
| Content | Simple impact problems Principles of analytical mechanics Elements of vibration theory Vibration of Multi-degree of freedom systems Multibody Systems Numerical methods for time integration Introduction to Matlab |
| Literature | K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011). W. Schiehlen, P. Eberhard: Technische Dynamik, Springer (2012). |

| Course L1138: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) | | |
|---|---|--|
| Тур | Typ Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Robert Seifried | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Course L1139: Mechanic | ourse L1139: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) | |
|------------------------|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Robert Seifried | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | |
|--|--|--|--|---|
| Fitle Practical Course: Measurem Measurement Technology fo | nent and Control Systems (L1119) or Mechanical and Process Engineers (L1116) or Mechanical and Process Engineers (L1118) | Typ Practical Course Lecture Recitation Section (large) | Hrs/wk 2 2 1 | CP 2 3 |
| Module Responsible | | (1.3.) | | |
| Admission Requirements | None | | | |
| · · · · · · · · · · · · · · · · · · · | Basic knowledge of physics, chemistry and e | lectrical engineering | | |
| | After taking part successfully, students have it | eached the following learning | results | |
| Professional Competence | | | | |
| | Students are able to name the most im (Quantities and Units, Uncertainty, Calibra Systems). | | | |
| Knowledge | They can outline the most important mea maesured (Electrical Quantities, Temperature | _ | | |
| | They can describe important methods of Chromatography) | chemical Analysis (Gas Se | ensors, Spe | ctroscopy, G |
| Skills | Students can select suitable measuring measurement devices in practice. The students are able to orally explain issusplution approaches as well as place the issue. | ues in the subject area of me | asurement i | technology a |
| Personal Competence Social Competence | Students can arrive at work results in groups | and document them in a comn | non report. | |
| Autonomy | Students are able to familiarize themselves w | vith new measurement technol | ogies. | |
| | Independent Study Time 110, Study Time in | _ecture 70 | | |
| Credit points | | | | |
| Studienleistung | Yes None Form Subject theory practical work | Description etical and | | |
| Examination | Written exam | | | |
| Examination duration and scale | 105 minutes | | | |
| | General Engineering Science (German Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German programmer) General Engineering Science (German programmer) General Engineering Science (German Environmental Engineering: Compulsory General Engineering Science (German programmer) General Engineering Science (German programmer) General Engineering Science (German programmer) | program): Specialisation ram): Specialisation Biomedica ram): Specialisation Process E program, 7 semester): Specialisation ram, 7 semester): Specialisation | Mechanica al Engineering: ingineering: pecialisation on Mechanic | Engineering: Compulso Compulsory Energy and Engineering |



General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

Assignment for the Energy and Environmental Engineering: Core qualification: Compulsory

Following Curricula General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

> General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory

> General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory

> General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

> General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



| Тур | Practical Course | |
|-------------------|--|--|
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | NN | |
| Language | DE | |
| Cycle | WiSe/SoSe | |
| | Experiment 1: Emission and immission measurement of gaseous pollutants: different technologie determine different gaseous pollutants in automotive exhaust are used. | |
| Content | Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dyna behaviour of e pump engine will be investigated. The starting will be simulated on a PC and compa with measurement. | |
| | Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will understood and applications with Michelson interferometer and optical fibers demonstrated. | |
| | Experiment 4:Identification of the parameters of a control system and optimal control parameters | |
| | Versuch 1: Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974 Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmi Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979 Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenhei Naturschutz und Umweltgestaltung Gebrauchs- und Bedienungsanweisungen VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 E 2455 Bl.1 Versuch 2: | |
| Literature | Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren Simulationsmethoden, speziell: Verwendung von Blockschaltbildern Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze | |
| | Versuch 3: Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Verleidelberg, 1984 Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech Ho Boston, 1988 Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Bos 1989 Versuch 4: Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelunge | |



| Tvn | Lecture |
|-------------------|--|
| Hrs/wk | |
| СР | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Dr. Sven Krause |
| Language | |
| Cycle | |
| | 1 Fundamentals 1.1 Quantities and Units |
| | 1.2 Uncertainty |
| | 1.3 Calibration |
| | 1.4 Static and Dynamic Properties of Sensors and Systems |
| | 2 Measurement of Electrical Quantities |
| | 2.1 Current and Voltage |
| | 2.2 Impedance |
| | 2.3 Amplification |
| | 2.4 Oscilloscope |
| | 2.5 Analog-to-Digital Conversion |
| Content | 2.6 Data Transmission |
| Content | 3 Measurement of Nonelectric Quantities |
| | 3.1 Temperature |
| | 3.2 Length, Displacement, Angle |
| | 3.3 Strain, Force, Pressure |
| | 3.4 Flow |
| | 3.5 Time, Frequency |
| | 4 Chemical Analysis |
| | 4.1 Gas Sensors |
| | 4.2 Spectroscopy |
| | 4.3 Gas Chromatography |
| | At the end of each lecture students present single measuring techniques and results orally in fron the class. |
| | Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Spring 2006, ISBN: 978-3-540-34055-3. |
| Literature | Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 9 3486217940. |



| Course L1118: Measure | ourse L1118: Measurement Technology for Mechanical and Process Engineers | |
|-----------------------|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dr. Sven Krause | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0865: Fu | ndamentals of Production | on and Quality Manageme | nt | |
|--|---|---------------------------------------|-------------------------|---------------------|
| Courses | | | | |
| Title Production Process Organiz Quality Management (L0926 | | Typ Lecture Lecture | Hrs/wk 2 2 | CP 3 3 |
| Module Responsible | Prof. Hermann Lödding | | | |
| Admission Requirements | , | | | |
| Recommended Previous Knowledge | None | | | |
| Educational Objectives | After taking part successfully, stu | dents have reached the following lea | arning results | |
| Professional Competence | | | | |
| Knowledge | Students are able to explain the | contents of the lecture of the module | | |
| Skills | Students are able to apply the me | ethods and models in the module to | industrial problem | S. |
| Personal Competence | | | | |
| Social Competence | - | | | |
| Autonomy | | | | |
| | Independent Study Time 124, Stu | udy Time in Lecture 56 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 180 Minuten | | | |
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Elective Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Elective Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory Mechanical Engineering: Core qualification: Elective Compulsory | | | |



| Course L0925: Production | ourse L0925: Production Process Organization | |
|--------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Hermann Lödding | |
| Language | | |
| Cycle | SoSe | |
| | (A) Introduction | |
| | (B) Product planning | |
| | (C) Process planning | |
| | (D) Procurement | |
| Content | (E) Manufacturing | |
| | (F) Production planning and control (PPC) | |
| | (G) Distribution | |
| | (H) Cooperation | |
| | Wiendahl, HP.: Betriebsorganisation für Ingenieure | |
| Literature | Vorlesungsskript | |

| Course L0926: Quality M | Course L0926: Quality Management | |
|-------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Hermann Lödding | |
| Language | EN | |
| Cycle | SoSe | |
| Content | Definition and Relevance of Quality Continuous Quality Improvement Quality Management in Product Development Quality Management in Production Processes Design of Experiments | |
| Literature | Pfeifer, Tilo: Quality Management. Strategies, Methods, Techniques; Hanser-Verlag, München 2002 Pfeifer, Tilo: Qualitätsmanagement. Strategien, Methoden, Techniken; Hanser-Verlag, München, 3. Aufl. 2001 Mitra, Amitava: Fundamentals of Quality Control and Improvement; Wiley; Macmillan, 2008 Kleppmann, W.: Taschenbuch Versuchsplanung. Produkte und Prozesse optimieren; Hanser-Verlag, München, 6. Aufl. 2009 | |



| Courses | | | | |
|--|--|---|---------------|-----------------|
| Title | | Тур | Hrs/wk | СР |
| Electrical Machines (L0293) | | Lecture | 3 | 4 |
| Electrical Machines (L0294) | | Recitation Section (large) | 2 | 2 |
| Module Responsible | Prof. Thanh Trung Do | | | |
| Admission Requirements | None | | | |
| Recommended | Basics of mathematics, in particular complexe | numbers, integrals, differenti | als | |
| | Basics of electrical engineering and mechanic | al engineering | | |
| Educational Objectives | After taking part successfully, students have re | ached the following learning | results | |
| Professional | | | | |
| Competence | | | | |
| | Students can to draw and explain the basic pr | inciples of electric and magn | etic fields. | |
| Knowledge | They can describe the function of the st corresponding equations and characteristic major parameters of the energy efficiency cengine. | curves. For typically used d | rives they | can explain the |
| | Students arw able to calculate two-dimension circuits with air gap. For this they apply the usu | = | • | _ |
| Skills | They can calulate the operational performance and selected quantities and characteristic graphical methods. | | | |
| Personal Competence | | | | |
| Social Competence | none | | | |
| Autonomy | Students are able independently to calculate able to analyse independently the operational data and theycan calculate thereof selected quality and the selected quality and | performance of electric mach | nines from th | • |
| Workload in Hours | Independent Study Time 110, Study Time in L | ecture 70 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 120 Minuten | | | |
| | General Engineering Science (German Engineering: Compulsory General Engineering Science (German programmer) General Engineering Science (German Environmental Engineering: Compulsory General Engineering Science (German programmer) Elective Compulsory Electrical Engineering: Core qualification: Electenergy and Environmental Engineering: Core | ram): Specialisation Mechanorogram, 7 semester): Specialisation, 7 semester): Specialisation trive Compulsory | nical Engin | eering: Electiv |
| Assignment for the Following Curricula | General Engineering Science (English pengineering: Compulsory General Engineering Science (English programmer) Compulsory General Engineering Science (English programmer) | program): Specialisation E | nical Engin | eering: Electiv |



Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering:

Elective Compulsory

Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory

 $\label{logistics} \mbox{Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory}$

Mechanical Engineering: Core qualification: Elective Compulsory

Mechatronics: Core qualification: Compulsory

| ourse L0293: Electrical Machines | |
|----------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Thanh Trung Do |
| Language | DE |
| Cycle | SoSe |
| Content | Electric field: Coulomb´s law, flux (field) line, work, potential, capacitor, energy, force Magnetic field: force, flux line, Ampere´s law, field at bounderies, flux, magnetic circuit, hysteresis, induction, self-induction, mutual inductance, transformer DC-Machines: Construction and layout, torque generation mechanismen, torque vs speed characteristics, commutation, Asynchronous Machines. Magnetic field, construction and layout, equivalent single line diagram, complex stator current diagram (Heylands´diagram), torque vs. speed characteristics, rotor layout (Squirrelcage vs. sliprings), Synchronous machines, construction and layout, equivalent single line diagrams, no-load and short-cuircuit characteristics, vector diagrams, motor and generator operation drives with variable speed, inverter fed operation, special drives, step motors, |
| Literature | Hermann Linse, Roland Fischer: "Elektrotechnik für Maschinenbauer", Vieweg-Verlag; Signatur der Bibliothek der TUHH: ETB 313 Ralf Kories, Heinz Schmitt-Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122 "Grundlagen der Elektrotechnik" - anderer Autoren Fachbücher "Elektrische Maschinen" |



| Course L0294: Electrical Machines | | |
|-----------------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Thanh Trung Do, Weitere Mitarbeiter | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Exercises to the application of electric and magnetic fields. Excercises to the operational performance of eletric machines. | |
| Literature | Hermann Linse, Roland Fischer: "Elektrotechnik für Maschinenbauer", Vieweg-Verlag; Signatur der Bibliothek der TUHH: ETB 313 Ralf Kories, Heinz Schmitt-Walter: "Taschenbuch der Elektrotechnik"; Verlag Harri Deutsch; Signatur der Bibliothek der TUHH: ETB 122 "Grundlagen der Elektrotechnik" - anderer Autoren Fachbücher "Elektrische Maschinen" | |



| Maradada Moood A | harran d Maladala | | | |
|--|---|--|-------------|----------------|
| Module M0934: Ad | Ivanced Materials | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Advanced Materials Charac | terization (L1087) | Lecture | 2 | 2 |
| Advanced Materials Design | • • | Lecture | 2 | 2 |
| Advanced Materials Design | (L1092) | Recitation Section (large) | 2 | 2 |
| Module Responsible | Prof. Patrick Huber | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Fundamentals of Materials Science (I and II) | | | |
| Educational Objectives | After taking part successfully, students have read | ched the following learning | results | |
| Professional | | | | |
| Competence | | | | |
| Knowledge | The students will be able to explain the properti in technology, in particular metallic, ceramic, po (biomaterials) and nanomaterials. | | | |
| Skills | The students will be able to select material configurations according to the technical needs and, if necessary, to design new materials considering architectural principles from the micro- to the macroscale. The students will also gain an overview on modern materials science, which enables them to select optimum materials combinations depending on the technical applications. | | | |
| Personal Competence | | | | |
| | The students are able to present solutions to spe | cialists and to develop idea | as further. | |
| Social Competence | | | | |
| Autonomy | The students are able to assess their own strengths and weaknes define tasks independently. | ses. | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lectu | ire 84 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 90 min | | | |
| Assignment for the Following Curricula | General Engineering Science (German program Compulsory General Engineering Science (German program Elective Compulsory General Engineering Science (English program Compulsory General Engineering Science (English program Elective Compulsory Machanical Engineering: Coro qualification: Elective Compulsory | , 7 semester): Specialisationm): Specialisation Mechar, 7 semester): Specialisatio | n Mechanic | al Engineering |

Mechanical Engineering: Core qualification: Elective Compulsory



| Course L1087: Advanced Materials Characterization | | |
|---|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Patrick Huber | |
| Language | DE | |
| Cycle | SoSe | |
| Content | | |
| Literature | William D. Callister und David G. Rethwisch, Materialwissenschaften und Werkstofftechnik, Wiley&Sons, Asia (2011). William D. Callister, Materials Science and Technology, Wiley& Sons, Inc. (2007). | |

| Course L1091: Advance | Course L1091: Advanced Materials Design | | |
|-----------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Bodo Fiedler, Prof. Stefan Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller | | |
| Language | DE/EN | | |
| Cycle | SoSe | | |
| Content | | | |
| Literature | Vorlesungsunterlagen | | |

| Course L1092: Advance | Course L1092: Advanced Materials Design | |
|-----------------------|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Bodo Fiedler, Prof. Stefan Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



Focus Biomechanics

Students with the emphasis Biomechanics get in addition to their core engineering skills, a basic understanding of the medical field focusing on fracture healing and implants. This enables them to understand operational planning as well as research and development in this highly interdisciplinary area.

| Module M0597: Ad | Ivanced Mechanical Engine | ering Design | | |
|---|---|--------------------------------------|-------------|----------------|
| Courses | | | | |
| | | T | Hue hada | OD. |
| Title Advanced Mechanical Engin | peoring Design II (1 0264) | Typ Lecture | Hrs/wk 2 | CP 2 |
| Advanced Mechanical Engin | | Recitation Section (large) | 2 | 1 |
| Advanced Mechanical Engin | | Lecture | 2 | 2 |
| Advanced Mechanical Engin | | Recitation Section (large) | 2 | 1 |
| Module Responsible | Prof. Dieter Krause | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | | | | |
| Educational Objectives | After taking part successfully, students | have reached the following learning | results | |
| Professional | ! | | | |
| Competence | ! ! | | | |
| Knowledge | After passing the module, students are able to: explain complex working principles and functions of machine elements and of basic elements of fluidics, explain requirements, selection criteria, application scenarios and practical examples o complex machine elements, indicate the background of dimensioning calculations. | | | |
| Skills | After passing the module, students are able to: accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem solving skills), recognize the content of technical drawings and schematic sketches, evaluate complex designs, technically. | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to discuss methods. | s technical information in the lectu | re supporte | d by activatin |
| Autonomy | Students are able to independently deepen their acquired knowledge in exercises. Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures. | | | |
| Workload in Hours | Independent Study Time 68, Study Tir | ne in Lecture 112 | | |
| Credit points | 6 | | | |
| Studienleistung | | | | |
| | Written exam | | | |
| Examination duration and scale | | | | |
| | General Engineering Science (Gern | nan program): Specialisation Mech | anical Engi | neering, Focu |



Energy Systems: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Assignment for the **Following Curricula**

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus **Energy Systems: Compulsory**

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Mechanical Engineering: Core qualification: Compulsory

Naval Architecture: Core qualification: Compulsory



| Course L0264: Advance | d Mechanical Engineering Design II |
|-----------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff |
| Language | DE |
| Cycle | SoSe |
| Content | Advanced Mechanical Engineering Design I & II Lecture • Fundamentals of the following machine elements: • Linear rolling bearings • Axes & shafts • Seals • Clutches & brakes • Belt & chain drives • Gear drives • Epicyclic gears • Crank drives • Sliding bearings • Elements of fluidics Exercise • Calculation methods of the following machine elements: • Linear rolling bearings • Axes & shafts • Clutches & brakes • Belt & chain drives • Belt & chain drives • Gear drives • Belt & chain drives • Gear drives • Gear drives • Gear drives • Giding bearings |
| Literature | Calculations of hydrostatic systems (fluidics) Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. |



| Course L0265: Advanced Mechanical Engineering Design II | |
|---|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| ourse L0262: Advance | d Mechanical Engineering Design I |
|----------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff |
| Language | DE |
| Cycle | WiSe |
| | Advanced Mechanical Engineering Design I & II |
| Content | • Fundamentals of the following machine elements: • Linear rolling bearings • Axes & shafts • Seals • Clutches & brakes • Belt & chain drives • Gear drives • Epicyclic gears • Crank drives • Sliding bearings • Elements of fluidics Exercise • Calculation methods of the following machine elements: • Linear rolling bearings • Axes & shafts • Clutches & brakes • Belt & chain drives • Gear drives • Gear drives • Gear drives • Gear drives • Epicyclic gears • Crank gears • Sliding bearings • Calculations of hydrostatic systems (fluidics) |
| Literature | Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F. Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springe Vieweg, aktuelle Auflage. |



| Course L0263: Advanced Mechanical Engineering Design I | |
|--|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| D I: Introduction to Anatomy | | | |
|--|---|--|---|
| | | | |
| | Тур | Hrs/wk | СР |
| 884) | Lecture | 2 | 3 |
| Prof. Udo Schumacher | | | |
| None | | | |
| | | | |
| None | | | |
| After taking part successfully, students h | ave reached the following le | earning results | |
| | | | |
| The students can describe basel structu | ures and functions of intern | al argans and the | musaulaskalata |
| | ires and functions of interna | ai organs and the i | nusculoskelela |
| The students can describe the basic made | croscopy and microscopy of | those systems. | |
| The students can recognize the relationship between given anatomical facts and the development of some common diseases; they can explain the relevance of structures and their functions in the context of widespread diseases. | | | |
| | | | |
| The students can participate in current discussions in biomedical research and medicine on a professional level. | | | |
| The students are able to access anatomical knowledge by themselves, can participate in conversations on the topic and acquire the relevant knowledge themselves. | | | |
| Independent Study Time 62, Study Time | in Lecture 28 | | |
| 3 | | | |
| None | | | |
| Written exam | | | |
| 90 minutes | | | |
| General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory | | | |
| | The students can describe basal structusystem. The students can recognize the relation some common diseases; they can explain of widespread diseases. The students can participate in curresprofessional level. The students are able to access a conversations on the topic and acquire to Independent Study Time 62, Study Time 3 None Written exam 90 minutes General Engineering Science (German Biomechanics: Compulsory General Engineering Science (German Compulsory General Engineering Science (English procus Biomechanics: Compulsory General Engineering: Specialisation Biomedical Engineering: Specialisation | Prof. Udo Schumacher None None After taking part successfully, students have reached the following leading to the students can describe basal structures and functions of internsystem. The students can describe the basic macroscopy and microscopy of the students can recognize the relationship between given anator some common diseases; they can explain the relevance of structure of widespread diseases. The students can participate in current discussions in biomedia professional level. The students are able to access anatomical knowledge by conversations on the topic and acquire the relevant knowledge then independent Study Time 62, Study Time in Lecture 28 None Written exam 90 minutes General Engineering Science (German program): Specialisation Bic General Engineering Science (German program, 7 semester): Specialisation Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomechanics: Compulsory General Engineering Science (English program): Specialisation Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomechanics: Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Mechanical Engineering: Specialisation Medical Technology and Cellistory Mechanical Engineering: Specialisation Medical Technology and Cellistory Mechanical Engineering: Specialisation Medical Technology and Cellistory Mechanical Engineering: Specialisation Management and Biomedical Engineering: Specialisation Management and Biomedical Engineering: Specialisation Management and Biomedical Engineering: Specialisation Manag | Prof. Udo Schumacher None None After taking part successfully, students have reached the following learning results The students can describe basal structures and functions of internal organs and the responsibility. The students can describe the basic macroscopy and microscopy of those systems. The students can describe the basic macroscopy and microscopy of those systems. The students can recognize the relationship between given anatomical facts and the some common diseases; they can explain the relevance of structures and their function of widespread diseases. The students can participate in current discussions in biomedical research and professional level. The students are able to access anatomical knowledge by themselves, can conversations on the topic and acquire the relevant knowledge themselves. Independent Study Time 62, Study Time in Lecture 28 3 None Written exam 90 minutes General Engineering Science (German program): Specialisation Biomedical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Enginemental Engineering Science (English program): Specialisation Biomedical Engineering Science (English program, 7 semester): Specialisation Mechanical Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Specialisation Biomedical Engineering Science (English program, 7 semester): Specialisation |



| ourse L0384: Introduct | | | |
|------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | ł. | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| | Prof. Tobias Lange | | |
| Language | | | |
| Cycle | SoSe | | |
| Content | General Anatomy 1st week: The Eucaryote Cell 2nd week: The Tissues 3rd week: Cell Cycle, Basics in Development 4th week: Musculoskeletal System 5th week: Cardiovascular System 6th week: Respiratory System 7th week: Genito-urinary System 8th week: Immune system 9th week: Digestive System II 10th week: Digestive System II 11th week: Endocrine System 12th week: Nervous System 13th week: Exam | | |
| Literature | Adolf Faller/Michael Schünke, Der Körper des Menschen, 16. Auflage, Thieme Verlag Stuttgart, 2012 | | |



| Courses | | | | |
|-----------------------------------|---|--|--|--|
| Title | | Тур | Hrs/wk | СР |
| Signals and Systems (L043) | | Lecture | 3 | 4 |
| Signals and Systems (L043) | | Recitation Section (small) | 2 | 2 |
| Module Responsible | | | | |
| Admission Requirements | None | | | |
| | Mathematics 1-3 | | | |
| | The modul is an introduction to the theory covered by the moduls Mathematik 1-3 is e (Fourier series, Fourier transform, Laplace tr | xpected. Further experience w | ith spectral | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The students are able to classify and desc methods of signal and system theory. The continuous-time and discrete-time signals a signals and systems mathematically in both effects in time domain and image domain signal to a discrete-time signal. | ey are able to apply the fund nd systems. They can describe time and image domain. In par | amental tra e and analy ticular, they | nsformations o se deterministi understand th |
| Skills | The students are able to describe and analy using methods of signal and system theory important properties such as magnitude and the impact of LTI systems on the signal properties. | r. They can analyse and design the design of | n basic sys earity etc T | tems regardin |
| Personal Competence | | | | |
| Social Competence | The students can jointly solve specific proble | | | |
| Autonomy | The students are able to acquire relevant in control their level of knowledge during the lighter system. | | | - |
| Workload in Hours | Independent Study Time 110, Study Time in | Lecture 70 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 90 min | | | |
| | General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German Engeneering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German prog General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory | gram): Specialisation Computer (gram): Specialisation Process E (gram): Specialisation Bioproces of program): Specialisation of program): Specialisation of program): Specialisation Biomedical (gram): Specialisation Biomedical (gram): Specialisation Specialisation of program, 7 semester): Specialisation of program of | Science: Congineering: s Engineering: s Engineering: Civil- and Mechanica al Engineering tion Electrical sation Contation Procession | ompulsory Compulsory ng: Compulsor Enviromenta I Engineering ng: Compulsor al Engineering nputer Science |



Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

Assignment for the

Following Curricula

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Theoretical Mechanical Engineering: Compulsory

Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,

Focus Theoretical Mechanical Engineering: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Computational Science and Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



| Course L0432: Signals a | nd Systems |
|-------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| | Independent Study Time 78, Study Time in Lecture 42 |
| | Prof. Gerhard Bauch |
| Language Cycle | |
| Content | Basic classification and description of continuous-time and discrete-time signals and systems Concvolution Power and energy of signals Correlation functions of deterministic signals Linear time-invariant (LTI) systems Signal transformations: Fourier-Series Fourier Transform Laplace Transform Discrete-time Fourier Transform Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT) Z-Transform Analysis and design of LTI systems in time and frequency domain Basic filter types Sampling, sampling theorem Fundamentals of recursive and non-recursive discrete-time filters |
| Literature | T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004 K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag. B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997 J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002 S. Haykin, B. van Veen: Signals and systems. Wiley. Oppenheim, A.S. Willsky: Signals and Systems. Pearson. Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson. |



| Course L0433: Signals and Systems | |
|-----------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Gerhard Bauch |
| Language | DE/EN |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M1979: ME | ED I: Introduction to Radiolo | ay and Radiation Thoron | v. | |
|--|---|--|-----------------|-----------------|
| | introduction to Hadiolo | gy and hadiation Therapy | y | |
| Courses | | | | |
| Title Introduction to Radiology an | d Radiation Therapy (L0383) | Typ Lecture | Hrs/wk 2 | CP 3 |
| Module Responsible | | | | |
| Admission | | | | |
| Requirements | | | | |
| Recommended Previous Knowledge | None | | | |
| Educational Objectives | After taking part successfully, students | have reached the following learning | g results | |
| Professional Competence | | | | |
| · | Therapy The students can distinguish different radiation therapy. The students can explain treatment p surgery, internal medicine). | | | |
| | The students can describe the patie care. | nts' passage from their initial adm | nittance throu | gh to follow-u |
| | Diagnostics | | | |
| Knowledge | The students can illustrate the ted angiography and mammography, as w | | _ | |
| | The students can explain the diagnos the technical basis for those technique | · · · · · · · · · · · · · · · · · · · | naging techniq | ues, as well a |
| | The students can choose the right treneeds. | eatment method depending on the | patient's clini | ical history an |
| | The student can explain the influence | of technical errors on the imaging to | echniques. | |
| | The student can draw the right conc protocol. | lusions based on the images' dia | ignostic findin | gs or the erro |
| | Therapy The students can distinguish curative conclusion. | e and palliative situations and mo | tivate why the | ey came to tha |
| | The students can develop adequate th | erapy concepts and relate it to the | radiation biolo | gical aspects. |
| | The students can use the therapeutic p | principle (effects vs adverse effects) | 1 | |
| | The students can distinguish different situation (location of the tumor) and ch | | | - |
| Skills | The student can assess what an in treatment, sports, social help groups, s | | | |
| | Diagnostics | | | |
| | The students can suggest solutions analyses. | for repairs of imaging instrumenta | ation after hav | ring done erro |
| | The students can classify results of based on their knowledge of anatomy, | | different grou | ps of disease |
| Personal Competence | | | | |
| , | The students can assess the special | social situation of tumor patients | and interact | with them in |
| Social Competence | professional way. The students are aware of the spec | sial, often fear-dominated behavio | or of sick peo | ple caused b |
| | | | | |



| | diagnostic and therapeutic measures and can meet them appropriately. |
|---|--|
| | The students can apply their new knowledge and skills to a concrete therapy case. The students can introduce younger students to the clinical daily routine. |
| Autonomy | The students are able to access anatomical knowledge by themselves, can participate competently in conversations on the topic and acquire the relevant knowledge themselves. |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Credit points | 3 |
| Studienleistung | None |
| Examination | Written exam |
| Examination duration and scale | 190 minutes |
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory |



| י א פי | Lecture |
|-------------------|--|
| Hrs/wk | 2 |
| СР | |
| | Independent Study Time 62, Study Time in Lecture 28 |
| | Prof. Ulrich Carl, Prof. Thomas Vestring |
| Language Cycle | |
| - | The students will be given an understanding of the technological possibilities in the field medical imaging, interventional radiology and radiation therapy/radiation oncology. It assumed, that students in the beginning of the course have heard the word "X-ray" at best will be distinguished between the two arms of diagnostic (Prof. Dr. med. Thomas Vestring) a therapeutic (Prof. Dr. med. Ulrich Carl) use of X-rays. Both arms depend on special big uni which determine a predefined sequence in their respective departments |
| | Technik der medizinischen Radiologie" von T. + J. Laubenberg – Auflage Besteelsen Örstenselsen und der der der der der der der der der de |
| | 7. Auflage – Deutscher Ärzteverlag – erschienen 1999 |
| | "Klinische Strahlenbiologie" von Th. Herrmann, M. Baumann und W. Dörr – |
| | 4. Auflage - Verlag Urban & Fischer – erschienen 02.03.2006 |
| | ISBN: 978-3-437-23960-1 |
| | "Strahlentherapie und Onkologie für MTA-R" von R. Sauer – |
| | 5. Auflage 2003 - Verlag Urban & Schwarzenberg – erschien 08.12.2009 |
| | ISBN: 978-3-437-47501-6 |
| Literature | "Taschenatlas der Physiologie" von S. Silbernagel und A. Despopoulu |
| | 8. Auflage – Georg Thieme Verlag - erschienen 19.09.2012 |
| | ISBN: 978-3-13-567708-8 |
| | "Der Körper des Menschen " von A. Faller u. M. Schünke - |
| | 16. Auflage 2004 – Georg Thieme Verlag – erschienen 18.07.2012 |
| | ISBN: 978-3-13-329716-5 |
| | "Praxismanual Strahlentherapie" von Stöver / Feyer – |
| | 1. Auflage - Springer-Verlag GmbH – erschienen 02.06.2000 |



| Courses | | | | | |
|--|--|--------------------------|--|-------------------------|-----------------|
| Title Computer Engineering (L032 Computer Engineering (L032 | | | Typ Lecture Recitation Section (small) | Hrs/wk 3 1 | CP 4 2 |
| Module Responsible | Prof. Heiko Falk | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | Basic knowledge in electrical engineering The successful completion of the labs will be honored during the evaluation of the module's examination according to the following rules: 1. Upon a passed module examination, the student is granted a bonus on the examination's marks due to the successful labs, such that the examination's marks are lifted by 0,3 or 0,4, respectively, up to the next-better grade. 2. The improvement of the grade 5,0 up to 4,3 and of 4,3 up to 4,0 is not possible. | | | | |
| Educational Objectives | After taking part success | sfully, students have re | ached the following learning | results | |
| Professional Competence | | | | | |
| Knowledge | Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture pipelining Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-poin connections, busses | | | | |
| Skills | The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physical composition of computer systems. The students can analyze, how highly specific and individual computers can be built based on a collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers of today computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencie between a physical computer system and the software executed on it. In particular, they shat understand the consequences that the execution of software has on the hardware-centric abstractio layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to proposite feasible options. | | | | |
| Personal Competence | | | | | |
| Social Competence | Students are able to solv | ve similar problems al | one or in a group and to pres | ent the resu | ts accordingly. |
| Autonomy | Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. | | | | |
| Workload in Hours | Independent Study Time | e 124, Study Time in Le | ecture 56 | | |
| Credit points | 6 | | | | |
| | Compulsory Bonus | Form | Description | | |



| Examination duration and scale | 90 minutes, contents of course and labs |
|--------------------------------|---|
| | General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and |
| | Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Energy Systems: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory |
| | General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental |
| | Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Energy Systems: Compulsory |



Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory

| Course L0321: Compute | er Engineering |
|-----------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Heiko Falk |
| Language | DE |
| Cycle | WiSe |
| Content | Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output |
| Literature | A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. |

| Course L0324: Computer Engineering | |
|------------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Heiko Falk |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | |
|---|--|------------------------------|--|------------------|
| Γitle | | Тур | Hrs/wk | СР |
| | and Molecular Biology (L0386) | Lecture | 2 | 3 |
| | Prof. Hans-Jürgen Kreienkamp | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | None | | | |
| Educational Objectives | After taking part successfully, students | have reached the following I | earning results | |
| Professional Competence | | | | |
| Competence | The students can | | | |
| Knowledge | describe basic biomolecules;explain how genetic informatioexplain the connection between | | | |
| Skills | The students can recognize the importance of m describe selected molecular-d explain the relevance of these | iagnostic procedures; | | |
| Personal Competence | | | | |
| Social Competence | The students can participate in discus | sions in research and medici | ne on a technical lev | /el. |
| Autonomy | The students can develop understa themselves. | nding of topics from the cor | urse, using technic | al literature, b |
| Workload in Hours | Independent Study Time 62, Study Tir | ne in Lecture 28 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 60 minutes | | | |
| Assignment for the Following Curricula | | | ng: Compulsor cal Engineering neering, Focung: Compulsor cal Engineering cal Engineering cal Engineering cation: Elective dicine: Elective | |



Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

| Course L0386: Introduction to Biochemistry and Molecular Biology | | |
|--|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Hans-Jürgen Kreienkamp | |
| Language | DE | |
| Cycle | WiSe | |
| Content | | |
| | Müller-Esterl, Biochemie, Spektrum Verlag, 2010; 2. Auflage | |
| | Löffler, Basiswissen Biochemie, 7. Auflage, Springer, 2008 | |
| Literature | | |
| | | |
| | | |
| | | |



| Courses | | | | |
|--|--|--|--|---|
| Title | 2447 | Тур | Hrs/wk | CP |
| Numerical Mathematics I (LI Numerical Mathematics I (LI | • | Lecture Recitation Section (small) | 2 | 3 3 |
| • | Prof. Sabine Le Borne | (| | |
| Admission | | | | |
| Requirements | None | | | |
| Recommended Previous Knowledge | Il for Technomathematicians | | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | |
| Professional Competence | | | | |
| | Students are able to | | | |
| Knowledge | name numerical methods for interpolation, integration, least squares problems, eigenvalu problems, nonlinear root finding problems and to explain their core ideas, repeat convergence statements for the numerical methods, explain aspects for the practical execution of numerical methods with respect to computations and storage complexitx. | | | |
| Skills | Students are able to implement, apply and compare numerical methods using MATLAB, justify the convergence behaviour of numerical methods with respect to the problem and solution algorithm, select and execute a suitable solution approach for a given problem. | | | |
| Personal Competence | | | | |
| | Students are able to | | | |
| Social Competence | work together in heterogeneously c and background knowledge), expl practical aspects regarding the imple | ain theoretical foundations an | | |
| | Students are capable | | | |
| Autonomy | to assess whether the supporting theoretical and practical excercises are better solved. | | | |
| Workload in Hours | Independent Study Time 124, Study Time in | Lecture 56 | | |
| Credit points | <u> </u> | _ | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 90 minutes | | | |
| | General Engineering Science (German prog General Engineering Science (German prog Biomechanics: Compulsory General Engineering Science (German prog Materials in Engineering Sciences: Compul General Engineering Science (German prog General Engineering Science (German prog Compulsory | rogram): Specialisation Mecharogram): Specialisation Mechasory gram): Specialisation Biomedica | anical Engi anical Engi al Engineeri | neering, Focuneering, Focung: Compulsor |



General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory Assignment for the Electrical Engineering: Core qualification: Elective Compulsory **Following Curricula** General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory Computational Science and Engineering: Core qualification: Compulsory

| Course L0417: Numeric | al Mathematics I |
|-----------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Sabine Le Borne, Dr. Patricio Farrell |
| Language | DE/EN |
| Cycle | WiSe |
| Content | Error analysis: Number representation, error types, conditioning and stability Interpolation: polynomial and spline interpolation Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, adaptive quadrature, difference formulas Linear systems: LU and Cholesky factorization, matrix norms, conditioning Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular value decomposition, regularization Eigenvalue problems: power iteration, inverse iteration, QR algorithm Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Quasi-Newton methods for systems |
| Literature | Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik für Ingenieure und Naturwissenschaftler, Springer |

Computational Science and Engineering: Core qualification: Compulsory Process Engineering: Specialisation Process Engineering: Elective Compulsory



| Course L0418: Numerical Mathematics I | |
|---------------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Sabine Le Borne, Dr. Patricio Farrell |
| Language | DE/EN |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | |
|--|--|--|---------------|------------------|
| Title | | Тур | Hrs/wk | СР |
| Introduction to Control Syste Introduction to Control Syste | , , | Lecture Recitation Section (small) | 2 2 | 4 2 |
| Module Responsible | Prof. Herbert Werner | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | | stems in time and frequency domain, Lap | lace transfor | m |
| Educational Objectives | After taking part successfully, stud | lents have reached the following learning | g results | |
| Professional Competence | | | | |
| Knowledge | Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequency response They can explain issues arising when controllers designed in continuous time domain are implemented digitally | | | |
| Skills | Students can transform models of linear dynamic systems from time to frequency domain and vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks | | | |
| Personal Competence | | | | |
| Social Competence | _ | ips to jointly solve technical problems, | and experim | nentally validat |
| Autonomy | their controller designs Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress. | | | |
| Workload in Hours | Independent Study Time 124, Stu | dv Time in Lecture 56 | | |
| Credit points | <u> </u> | 5) 1.1110 III 200.010 00 | | |
| Studienleistung | | | | |
| | Written exam | | | |
| Examination duration and scale | <u> </u> | | | |
| | General Engineering Science (Ge | erman program): Core qualification: Com German program, 7 semester): Specia | | nputer Sciend |



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

General Engineering Science (English program): Core qualification: Compulsory

Assignment for the General Englowing Curricula Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory



Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective

Compulsory

Process Engineering: Core qualification: Compulsory

| Course L0654: Introduct | ion to Control Systems |
|-------------------------|--|
| Тур | Lecture |
| Hrs/wk | |
| СР | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. Herbert Werner |
| Language | DE |
| Cycle | WiSe |
| Content | Signals and systems Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle Root locus techniques Root locus design of PID controllers Frequency response techniques |
| | Software tools |
| | Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course |
| Literature | Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems' Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010 |



| Course L0655: Introduction to Control Systems | |
|---|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Herbert Werner |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M1333: BIC |) I: Implants and Fracture He | aling | | |
|--|--|---------------------------------|--------------------|------------------|
| • | | | | |
| Courses | | _ | | |
| Title Implants and Fracture Healir | ng (L0376) | Typ Lecture | Hrs/wk 2 | CP 3 |
| Module Responsible | Prof. Michael Morlock | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | It is recommended to participate in "Fracture Healing". | Introduction into Anatomie" b | pefore attending | "Implants and |
| Educational Objectives | After taking part successfully, students h | ave reached the following lear | ning results | |
| Professional Competence | | | | |
| Knowledge | The students can describe the different ways how bones heal, and the requirements for their existence. The students can name different treatments for the spine and hollow bones under given fracture morphologies. The students can determine the forces acting within the human body under quasi-static situations | | | |
| | under specific assumptions. | s acting within the number both | uy under quasi-s | static situation |
| Personal Competence | | | | |
| Social Competence | The students can, in groups, solve basic numerical modeling tasks for the calculation of internal forces. | | | |
| Autonomy | The students can, in groups, solve basic | numerical modeling tasks for t | the calculation of | internal forces |
| | Independent Study Time 62, Study Time | in Lecture 28 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| Examination Examination duration | | | | |
| and scale | 90 min | | | |
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Mechanical Engineering, Focu Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focu Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory | | | |



| Course L0376: Implants | and Fracture Healing |
|------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | |
| | Independent Study Time 62, Study Time in Lecture 28 |
| | Prof. Michael Morlock |
| Language Cycle | |
| | Topics to be covered include: |
| | Introduction (history, definitions, background importance) |
| | 2. Bone (anatomy, properties, biology, adaptations in femur, tibia, humerus, radius) |
| | 3. Spine (anatomy, biomechanics, function, vertebral bodies, intervertebral disc, ligaments) |
| | 3.1 The spine in its entirety |
| | 3.2 Cervical spine |
| | 3.3 Thoracic spine |
| | 3.4 Lumbar spine |
| | 3.5 Injuries and diseases |
| | 4. Pelvis (anatomy, biomechanics, fracture treatment) |
| Content | 5 Fracture Healing |
| | 5.1 Basics and biology of fracture repair |
| | 5.2 Clinical principals and terminology of fracture treatment |
| | 5.3 Biomechanics of fracture treatment |
| | 5.3.1 Screws |
| | 5.3.2 Plates |
| | 5.3.3 Nails |
| | 5.3.4 External fixation devices |
| | 5.3.5 Spine implants |
| | 6.0 New Implants |
| | Cochran V.B.: Orthopädische Biomechanik |
| | |
| Literature | Mow V.C., Hayes W.C.: Basic Orthopaedic Biomechanics |
| | White A.A., Panjabi M.M.: Clinical biomechanics of the spine |
| | Nigg, B.: Biomechanics of the musculo-skeletal system |
| | Schiebler T.H., Schmidt W.: Anatomie |
| | Platzer: dtv-Atlas der Anatomie, Band 1 Bewegungsapparat |
| | |
| | |



| Module M1280: ME | ED II: Introduction to Physiolog | ду | | |
|--------------------------------|--|------------------------------|-----------------|----|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Introduction to Physiology (I | .0385) | Lecture | 2 | 3 |
| Module Responsible | Dr. Roger Zimmermann | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | None | | | |
| | After taking part successfully, students ha | ave reached the following le | earning results | |
| Professional Competence | The students can | | | |
| Knowledge | describe the basics of the energy metabolism: | | | |
| Skills | The students can describe the effects of basic bodily functions (sensory, transmission and processing of information, development of forces and vital functions) and relate them to similar technical systems. | | | |
| Personal Competence | | | | |
| Social Competence | The students can conduct discussions in research and medicine on a technical level. The students can find solutions to problems in the field of physiology, both analytical and metrological. | | | |
| Autonomy | The students can derive answers to questions arising in the course and other physiological areas, using technical literature, by themselves. | | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | | |
| Credit points | 3 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 60 minutes | | | |
| | General Engineering Science (German program): Specialisation Mechanical Engineering, Foc Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Biomechanics: Compulsory General Engineering: Specialisation Medical Technology: Elective Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Foc Biomechanics: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulso General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineerin Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineerin Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Regenerative Medicine: Electic Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Electic Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory | | | |



| Course L0385: Introduction to Physiology | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Dr. Roger Zimmermann | |
| Language | DE | |
| Cycle | SoSe | |
| Content | | |
| | Taschenatlas der Physiologie, Silbernagl Despopoulos, ISBN 978-3-135-67707-1, Thieme | |
| Literature | Repetitorium Physiologie, Speckmann, ISBN 978-3-437-42321-5, Elsevier | |



| Module M0829: Fo | undations of Management | | | |
|--|--|------------------------------------|---------|--------|
| Courses | | | | |
| Title | 0 | Typ | Hrs/wk | CP |
| Management Tutorial (L0882 Introduction to Management | | Recitation Section (large) Lecture | 2 3 | 3 3 |
| Module Responsible | Prof. Christoph Ihl | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | | ss | | |
| Educational Objectives | After taking part successfully, students have r | eached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Management, from Planning and Organisation to Marketing and Innovation, and also to Investmen and Controlling. In particular they are able to explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management explain the most important aspects of and goals in Management and name the most important aspects of entreprenaurial projects. | | | |
| Skills | Students are able to analyse business units with respect to different criteria (organization, objectives strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to • analyse Management goals and structure them appropriately • analyse organisational and staff structures of companies • apply methods for decision making under multiple objectives, under uncertainty and under risk • analyse production and procurement systems and Business information systems • analyse and apply basic methods of marketing • select and apply basic methods from mathematical finance to predefined problems • apply basic methods from accounting, costing and controlling to predefined problems | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a coherence report on the project to communicate appropriately and to cooperate respectfully with their fellow students. | | | |
| Autonomy | Students are able to work in a team and to organize the team themselves to write a report on their project. | | | |
| | Independent Study Time 110, Study Time in L | Lecture 70 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| | Subject theoretical and practical work | | | |
| Examination duration | | | | |



and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

Assignment for the Following Curricula

Compulsory

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:



Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

| Course L0882: Managen | nent Tutorial |
|-----------------------|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Christoph Ihl, Katharina Roedelius, Tobias VIcek |
| Language | DE |
| Cycle | WiSe/SoSe |
| Content | In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools. If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on self-selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the business knowledge from the lecture should come to practical use. The group projects are guided by a mentor. |
| Literature | Relevante Literatur aus der korrespondierenden Vorlesung. |



| rse L0880: Introduct | ion to Management | | |
|----------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 3 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | |
| Lecturer | Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrir Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona | | |
| Language | DE | | |
| Cycle | WiSe/SoSe | | |
| Content | Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects | | |
| Literature | Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttga 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006. | | |



| Module M1332: Blo | O I: Experimental Methods | s in Biomechanics | |
|--|--|--|----------------------------|
| Courses | | | |
| Title Experimental Methods in Bio | mechanics (L0377) | Typ Lecture | Hrs/wk CP 2 3 |
| Module Responsible | Prof. Michael Morlock | | |
| Admission Requirements | None | | |
| Recommended Previous Knowledge | 1 M - tl l II | | |
| Educational Objectives | After taking part successfully, stude | nts have reached the following lear | ning results |
| Professional Competence Knowledge | existence. The students can name different morphologies. | different ways how bones heal, a treatments for the spine and holl of the difference of the spine and holl of the spine and the spine an | ow bones under given fract |
| Skills | The students can describe the biomechanics. | basic handling of several exp | erimental techniques used |
| Personal Competence Social Competence Autonomy | The students can, in groups, solve | | |
| Workload in Hours | I | | |
| Credit points | 3 | | |
| Studienleistung | None | | |
| Examination | Written exam | | |
| Examination duration and scale | 90 min | | |
| _ | General Engineering Science (German program): Specialisation Mechanical Engineering, Focu Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focu Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory | | |



| Course L0377: Experimental Methods in Biomechanics | |
|--|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Michael Morlock |
| Language | DE |
| Cycle | SoSe |
| Content | |
| Literature | Wird in der Veranstaltung bekannt gegeben |



Focus Energy Systems

The aim of the specialization Energy Systems in the field of study Mechanical Engineering of the course of study General Engineering Science is to familiarize students with different technologies for energy conversion, energy distribution and energy application. Graduates are qualified to analyse, abstract and model processes. They are able to evaluate data and results and to develop strategies for finding innovative, energy efficient solutions. They take the connection of different problems into account. Furthermore the graduates are able to document and to communicate scientific results.

The specialization Energy Systems enables a consecutive study of the Master Energy Systems or an economical oriented master study.

| | mputer Engineering | | | |
|--|--|---|---|--|
| Courses | | | | |
| Title Computer Engineering (L03: Computer Engineering (L03: | • | Typ Lecture Recitation Section (small) | Hrs/wk 3 1 | CP 4 2 |
| Module Responsible | Prof. Heiko Falk | | | |
| Admission Requirements | | | | |
| Recommended Previous Knowledge | Basic knowledge in electrical engineering The successful completion of the labs will be examination according to the following rules: 1. Upon a passed module examination, the marks due to the successful labs, such the respectively, up to the next-better grade. 2. The improvement of the grade 5,0 up to 4,3 | student is granted a boat the examination's ma | onus on the | e examination |
| Educational Objectives | After taking part successfully, students have reach | ed the following learning | results | |
| Professional Competence | | | | |
| Knowledge | This module deals with the foundations of the fun from the assembly-level programming down to gat Introduction Combinational logic: Gates, Boolean a combinational networks Sequential logic: Flip-flops, automata, syste Technological foundations Computer arithmetic: Integer addition, subt Basics of computer architecture: Prograpipelining Memories: Memory hierarchies, SRAM, DR Input/output: I/O from the perspective of the connections, busses | es. The module includes algebra, Boolean function and amming models, MIPS AM, caches the CPU, principles of p | the followin ons, hardw d division single-cyc | g topics: vare synthesis le architecture a, point-to-poir |
| | The students perceive computer systems from the structure and the physical composition of compu | • • | • | • |



| 21.11 | specific and individual computers can be built based on a collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers of today's computing systems - from gates and circuits up to complete processors. | | |
|--------------------------------|---|--|--|
| Skills | After successful completion of the module, the students are able to judge the interdependencies between a physical computer system and the software executed on it. In particular, they shall understand the consequences that the execution of software has on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to propose feasible options. | | |
| Personal Competence | | | |
| Social Competence | Students are able to solve similar problems alone or in a group and to present the results accordingly. | | |
| Autonomy | Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | |
| Credit points | 6 | | |
| Studienleistung | Compulsory Bonus Form Description Yes 10 % Excercises | | |
| Examination | Written exam | | |
| Examination duration and scale | 90 minutes, contents of course and labs | | |
| | General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: | | |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory | | |
| | General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory | | |
| | General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory | | |
| | General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory | | |
| | General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory | | |
| | General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory | | |
| | General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, | | |
| | Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, | | |
| | Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, | | |
| | Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, | | |
| | Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, | | |
| | Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory | | |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory | | |
| | Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory | | |
| Assignment for the | General Engineering Science (English program): Core qualification: Compulsory | | |
| Following Curricula | General Engineering Science (English program, 7 semester): Specialisation Computer Science: | | |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory | | |
| | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory | | |
| | General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: | | |



Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation II. Informatics: Elective Compulsory

| Course L0321: Compute | r Engineering | | |
|-----------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | | | |
| СР | 4 | | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | | |
| Lecturer | Prof. Heiko Falk | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output | | |
| Literature | A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. | | |



| Course L0324: Computer Engineering | |
|------------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Heiko Falk |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Modulo M0672: Sid | gnals and Systems | | | |
|--|---|---|--|---|
| Module Moo72. Siç | griais and Systems | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | CP |
| Signals and Systems (L0432 Signals and Systems (L0433 | | Lecture Recitation Section (small) | 3 2 | 4 2 |
| Module Responsible | Prof. Gerhard Bauch | | | |
| Admission Requirements | None | | | |
| · | Mathematics 1-3 | | | |
| | The modul is an introduction to the theory o covered by the moduls Mathematik 1-3 is experience (Fourier series, Fourier transform, Laplace transform). | ected. Further experience w | ith spectral | |
| Educational Objectives | After taking part successfully, students have rea | ached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The students are able to classify and describe methods of signal and system theory. They continuous-time and discrete-time signals and signals and systems mathematically in both time effects in time domain and image domain whisignal to a discrete-time signal. | are able to apply the funda systems. They can describe te and image domain. In par | amental trai e and analys ticular, they | nsformations of se deterministic understand the |
| Skills | The students are able to describe and analyse using methods of signal and system theory. T important properties such as magnitude and p the impact of LTI systems on the signal properti | hey can analyse and desig hase response, stability, line | n basic sys earity etc T | tems regarding |
| Personal Competence | | | | |
| Social Competence | The students can jointly solve specific problems | S. | | |
| Autonomy | The students are able to acquire relevant info control their level of knowledge during the lec- clicker system. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Le | cture 70 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 90 min | | | |
| | General Engineering Science (German program General Engineering Science (German Engeneering: Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program Compulsory | m): Specialisation Computer m): Specialisation Process E m): Specialisation Bioproces program): Specialisation program): Specialisation m): Specialisation Biomedica am, 7 semester): Specialisation ram, 7 semester): Specialisation m, 7 semester): Specialisation m, 7 semester): Specialisation m, 7 semester): Specialisation m, 7 semester): Specialisation | Science: Congineering: s Engineering: s Engineering | ompulsory Compulsory ng: Compulsory Enviromenta Engineering ng: Compulsory al Engineering uputer Science as Engineering as Engineering as Engineering |
| | General Engineering Science (German program | n, / semesier): Specialisatio | n wechanic | aı Engineering |



Focus Biomechanics: Compulsory

Assignment for the

Following Curricula

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Theoretical Mechanical Engineering: Compulsory Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



| Course L0432: Signals a | nd Systems |
|-------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | |
| | Independent Study Time 78, Study Time in Lecture 42 |
| | Prof. Gerhard Bauch |
| Language Cycle | |
| Content | Basic classification and description of continuous-time and discrete-time signals and systems Concvolution Power and energy of signals Correlation functions of deterministic signals Linear time-invariant (LTI) systems Signal transformations: Fourier-Series Fourier Transform Laplace Transform Discrete-time Fourier Transform Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT) Z-Transform Analysis and design of LTI systems in time and frequency domain Basic filter types Sampling, sampling theorem Fundamentals of recursive and non-recursive discrete-time filters |
| Literature | T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004 K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag. B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997 J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002 S. Haykin, B. van Veen: Signals and systems. Wiley. Oppenheim, A.S. Willsky: Signals and Systems. Pearson. Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson. |



| Course L0433: Signals and Systems | |
|-----------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Gerhard Bauch |
| Language | DE/EN |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | | | | | |
|--|--|--|--|---|--|---|--------------------------------------|--------------------------------|
| Title | | | Туј | p | Hrs | /wk | СР | |
| Heat Transfer (L0458) Heat Transfer (L0459) | | | | cture citation Section (larg | 3 je) 2 | | 4 2 | |
| Module Responsible | Dr. Andreas Moschallski | | | | | | | |
| Admission Requirements | None | | | | | | | |
| Recommended Previous Knowledge | Technical Thermodynamics I, II | and Fluid | Dynamics | | | | | |
| Educational Objectives | After taking part successfully, s | udents hav | ve reached t | he following learn | ing resul | ts | | |
| Professional Competence | | | | | | | | |
| | The students are able to | | | | | | | |
| | - describe the different physical | mechanis | m of Heat Tr | ansfer, | | | | |
| Knowledge | - explain the technical terms, | | | | | | | |
| | - to analyse comlex heat transfe | er processe | es in a critica | al way. | | | | |
| | The students are able to | | | | | | | |
| | - understand the physics of Hea | at Transfer, | | | | | | |
| Skills | - calculate and evaluate complex Heat Transfer processes, | | | | | | | |
| | - solve excersises self-consiste | nt and in s | mall groups. | | | | | |
| Personal Competence | | | | | | | | |
| Social Competence | The students are able to discus | s in small (| groups and o | develop an appro | ach. | | | |
| | The students are able to dev critical way. A qualified exchan | | | | t and an | alyse th | ne resul | ts in |
| Workload in Hours | I Independent Study Time 110, S | Study Time | in Lecture 7 | 0 | | | | |
| Credit points | | | | | | | | |
| Studienleistung | | | | | | | | |
| Examination | Written exam | | | | | | | |
| Examination duration and scale | 120 min | | | | | | | |
| | General Engineering Science Biomechanics: Compulsory General Engineering Science Energy Systems: Compulsory General Engineering Science (General Engineering Science Theoretical Mechanical Engine General Engineering Science (Focus Energy Systems: Compu- General Engineering Science (Focus Theoretical Mechanical | (German programment (German programment) German programment) German programment programment) German programment) | program): Spe program): hpulsory ogram, 7 se rogram, 7 se | Specialisation Mecialisation Biome Specialisation Memoster): Specialismester): Specialismester): Specialismester): Specialismester): Specialismester) | echanica dical Eng echanica sation Me | I Engir lineerin I Engir chanica | neering, ng: Comp neering, al Engine | Foci oulso Foci eerin |
| | General Engineering Science (Compulsory | German pi | rogram, 7 se | emester): Specialis | | | | |
| Assignment for the Following Curricula | General Engineering Science (General Engineering Science Biomechanics: Compulsory | | | | | | | |
| | General Engineering Science Energy Systems: Compulsory General Engineering Science | | | • | | _ | | |
| | , all and the second se | | | | | 9" | | |



Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Energy Systems: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
Compulsory
Mechanical Engineering: Specialisation Energy Systems: Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

| Course L0458: Heat Transfer | | |
|-----------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| СР | 4 | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | |
| Lecturer | Dr. Andreas Moschallski | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Dimensional analysis, heat conduction, convective heat transfer, Two-phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods | |
| Literature | - Herwig, H.; Moschallski, A.: Wärmeübertragung, 3. Auflage, Springer Vieweg Verlag, Wiesbaden, 2014 - Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000 - Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996 | |

| Course L0459: Heat Transfer | |
|-----------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Andreas Moschallski |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| itle | | Тур | Hrs/wk | СР |
|--|--|---------------------------------------|--------------|----------------|
| ntroduction to Control Syste ntroduction to Control Syste | • | Lecture Recitation Section (small) | 2 | 4 2 |
| Module Responsible | Prof. Herbert Werner | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Representation of signals and systems in | time and frequency domain, Lapl | ace transfor | m |
| Educational Objectives | After taking part successfully, students ha | ive reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequency response They can explain issues arising when controllers designed in continuous time domain are implemented digitally | | | |
| Skills | Students can transform models of linear dynamic systems from time to frequency domain and vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks | | | |
| Personal Competence | | | | |
| Social Competence | Students can work in small groups to justine a state line of the control of the c | pintly solve technical problems, a | nd experim | entally valida |
| Autonomy | their controller designs Students can obtain information from experiment guides) and use it when solvi They can assess their knowledge in wee | ng given problems. | | |
| Workload in Hours | Independent Study Time 124, Study Time | e in Lecture 56 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| Examination | | | | |
| Examination duration and scale | 120 min | | | |



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

General Engineering Science (English program): Core qualification: Compulsory

Assignment for the General Englowing Curricula Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory



Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective

Compulsory

Process Engineering: Core qualification: Compulsory

| Course L0654: Introduct | ion to Control Systems |
|-------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. Herbert Werner |
| Language | DE |
| Cycle | WiSe |
| Content | Signals and systems Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle Root locus techniques Root locus design of PID controllers Frequency response techniques Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Time delay systems Root locus and frequency response of time delay systems Smith predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course |
| Literature | Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems' Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010 |



| Course L0655: Introduction to Control Systems | |
|---|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Herbert Werner |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M0597: Ac | dvanced Mechanical Engineering | ı Design | | |
|--|--|--|---|-----------------|
| Courses | | | | |
| TitleTypHrs/vAdvanced Mechanical Engineering Design II (L0264)Lecture2Advanced Mechanical Engineering Design II (L0265)Recitation Section (large)2 | | | 2 | CP 2 1 |
| Advanced Mechanical Engir Advanced Mechanical Engir | | Lecture Recitation Section (large) | 2 | 2 1 |
| Module Responsible | Prof. Dieter Krause | | | |
| Admission Requirements | INONA | | | |
| Recommended Previous Knowledge | | ering Design | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | After passing the module, students are able explain complex working principles a | and functions of machine elem teria, application scenarios aning calculations. | | |
| Skills | accomplish dimensioning calculation transfer knowledge learned in the r skills), recognize the content of technical drate evaluate complex designs, technicall | module to new requirements a awings and schematic sketches | and tasks (p | oroblem solving |
| Personal Competence | , | | | |
| Social Competence | Students are able to discuss technology methods. | nical information in the lectu | e supporte | d by activating |
| Autonomy | Students are able to independently d Students are able to acquire addit content e.g. by using the video record | ional knowledge and to reca | | |
| Workload in Hours | Independent Study Time 68, Study Time in L | ecture 112 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| | Written exam | | | |
| Examination duration and scale | 1120 | | | |
| | General Engineering Science (German preserved Systems: Compulsory General Engineering Science (German preserved Systems Engineering: Compulsory General Engineering Science (German preserved Engineering Sciences: Compulsory General Engineering Science (German preserved Engineering Engineeri | rogram): Specialisation Mechanogram): Specialisation Mechanogram): Specialisation Mechanogram): Specialisation Mechanogram | anical Engi anical Engi anical Engi | neering, Focus |



Product Development and Production: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Assignment for the Following Curricula

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory



| | d Mechanical Engineering Design II | | |
|-------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff | | |
| Language | DE | | |
| Cycle | SoSe | | |
| | Advanced Mechanical Engineering Design I & II | | |
| Content | Fundamentals of the following machine elements: | | |
| Literature | Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Spring Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktue Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Spring Vieweg, aktuelle Auflage. | | |



| Course L0265: Advanced Mechanical Engineering Design II | |
|---|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Course L0262: Advance | d Mechanical Engineering Design I | | |
|-----------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | of. Dieter Krause, Prof. Otto von Estorff | | |
| Language | E | | |
| Cycle | WiSe | | |
| | Advanced Mechanical Engineering Design I & II | | |
| Content | Fundamentals of the following machine elements: | | |
| Literature | Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F. Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. | | |



| Course L0263: Advanced Mechanical Engineering Design I | |
|--|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | |
|---|--|---|--|--------|
| Title | | Тур | Hrs/wk | СР |
| Computational Fluid Dynamics I (L0235) Computational Fluid Dynamics I (L0419) | | Lecture Recitation Section (large) | 2 | 3 3 |
| Module Responsible | Prof. Thomas Rung | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Mathematical Methods for EngineeFundamentals of Differential/integral | | s | |
| Educational Objectives | After taking part successfully, students have | ve reached the following learning | results | |
| Professional Competence | The students are able to list the basic num | porice of partial differential equation | nne | |
| Knowledge | The students are able to list the basic num | ierios or partial differential equatio | лі5. | |
| Skills | The students are able develop appropria partial differential equations. They can co | = | | _ |
| Personal Competence | The students can arrive at work results in | groups and document them. | | |
| Autonomy | The students can independently analyse | approaches to solving specific pro | oblems. | |
| Workload in Hours | Independent Study Time 124, Study Time | in Lecture 56 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 2h | | | |
| Assignment for the Following Curricula | IC-chord Engineering Science (English program). Specialisation Mechanical Engineering Ed | | ompulsory ral Architecture cal Engineering ompulsory neering, Focu | |



| Course L0235: Computa | tional Fluid Dynamics I | | |
|-----------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Thomas Rung | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Fundamentals of computational modelling of thermofluid dynamic problems. Development of numerical algorithms. 1. Partial differential equations 2. Foundations of finite numerical approximations 3. Computation of potential flows 4. Introduction of finite-differences 5. Approximation of convective, diffusive and transient transport processes 6. Formulation of boundary conditions and initial conditions 7. Assembly and solution of algebraic equation systems 8. Facets of weighted -residual approaches 9. Finite volume methods 10. Basics of grid generation | | |
| Literature | Ferziger and Peric: Computational Methods for Fluid Dynamics, Springer | | |

| Course L0419: Computational Fluid Dynamics I | | |
|--|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Thomas Rung | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | | |
|------------------------------------|--|----------------------|--|-----------|-------------|
| Γitle | | | Тур | Hrs/wk | СР |
| Gas and Steam Power Plan | , , | | Lecture | 3 | 4 |
| Gas and Steam Power Plan | ts (L0210) | | Recitation Section (large) | 2 | 2 |
| Module Responsible | Prof. Alfons Kather | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | "Heat Transfer" | modynamics I and | II" | | |
| Educational Objectives | After taking part success | sfully, students hav | ve reached the following learning | g results | |
| Professional Competence | | | | | |
| Knowledge | The students can evaluate the development of the electricity demand and the energy conversion routes in the thermal power plant, describe the various types of power plant and the layout of the steam generator block. They are also able to determine the operation characteristics of the power plant. Additionally they can describe the exhaust gas cleaning apparatus and the combination possibilities of conventional fossil-fuelled power plants with solar thermal and geothermal power plants or plants equipped with Carbon Capture and Storage. The students have basic knowledge about the principles, operation and design of turbomachinery | | | | |
| Skills | Within the framework of the exercise the students learn the use of the specialised software sui EBSILON Professional TM . With this tool small practical tasks are solved with the PC, to highlig aspects of the design and development of power plant cycles. The students are able to do simplified calculations on turbomachinery either as part of a plant, a | | | | |
| | single component or at | stage ievei. | | | |
| Personal Competence |] 1 | a francis of the | and the same and the same of t | | tarani di E |
| Social Competence | An excursion within the framework of the lecture is planned for students that are interested. T students get in this manner direct contact with a modern power plant in this region. The students v obtain first-hand experience with a power plant in operation and gain insights into the conflict between technical and political issues. | | | | |
| Autonomy | The students assisted by the tutors will be able to develop alone simple simulation models and rur with these scenario analyses. In this manner the theoretical and practical knowledge from the lecture is consolidated and the potential effects from different process combinations and boundary conditions highlighted. The students are able independently to analyse the operational performance of steam power plants and calculate selected quantities and characteristic curves. | | | | |
| | Independent Study Time | e 110, Study Time | in Lecture 70 | | |
| Workload in Hours | masponasm state in the | | | | |
| Workload in Hours Credit points | <u> </u> | | | | |



| Studienleistung | No 5 % | Attestation | EBSILON Professional; nur bestanden/nicht bestanden (keine |
|--------------------------------|--|---------------|--|
| | No 5 % | Excercises | ୩୩ teil ଅନ୍ତେମ୍ପ୍ରିୟେ ଐକ୍ତି aben im Laufe der Vorlesungen à 5 Minuten; bis zu 5 % Bonus je nach Anteil richtiger Abgaben |
| Examination | Written exam | | |
| Examination duration and scale | Written examinat | on of 120 min | |
| _ | General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Elective Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Elective Compulsory Mechanical Engineering: Specialisation Energy Systems: Compulsory | | |



| Course L0206: Gas and | Steam Power Plants |
|-----------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Alfons Kather |
| Language | DE |
| Cycle | WiSe |
| | In the 1 st part of the lecture an overview on thermal power plants is offered, including: • Electricity demand and Forecasting |
| | Thermodynamic fundamentals Energy Conversion in thermal power plants Types of power plant Layout of the power plant block |
| | Individual elements of the power plant Cooling systems Flue gas cleaning |
| | Operation characteristics of the power plant Construction materials for power plants Location of power plants Solar thermal plants/geothermal plants/Carbon Capture and Storage plants. |
| Content | These are complemented in the 2 nd part of the module by the more specialised issues: |
| | Energy balance of a turbomachine Theory of turbine and compressor stage Equal and positive pressure blading Flow losses |
| | Characteristic numbers Axial and radial design Design features Hydraulic turbomachines Pump and water turbine designs |
| | Design examples of reciprocating engines and turbomachinery Steam power plants Gas turbine systems. |
| Literature | Kalide: Kraft- und Arbeitsmaschinen Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985 Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006 Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990 Bohn, T. (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke Heizkraftwerke und Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland |



| | Steam Power Plants Desiration Section (large) |
|-------------------|---|
| | Recitation Section (large) |
| Hrs/wk | - |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Alfons Kather |
| Language | DE |
| Cycle | WiSe |
| Content | In the 1 st part of the lecture a general introduction into fluid-flow machines and steam power plant offered, including: • Energy balance of a fluid-flow machine • Theory of turbine and compressor stage • Equal and positive pressure blading • Flow losses • Characteristic numbers • Axial and radial design • Design features • Hydraulic fluid-flow machines • Pump and water turbine designs • Design examples of reciprocating engines and turbomachinery • Steam power plants • Gas turbine systems • Diesel engine systems • Diesel engine systems • Waste heat utilisation followed by the more specialised issues: • Electricity Demand and Forecasting • Thermodynamic fundamentals • Energy Conversion in Thermal Power Plants • Types of Power Plant • Layout of the power plant block • Individual elements of the power plant • Cooling systems |
| | Flue gas cleaning Operation characteristics of the power plant Construction materials Location of power plants The environmental impact of acidification, fine particulate or CO ₂ emissions and the resulting climateristics are a special focus of the lecture and the lecture hall exercise. The challenges in place of power plants and renewable energy sources a discussed and the technical options for providing security of supply and network stability presented, also under consideration of cost effectiveness. In this critical review, focus is especially placed on the compatibility of the different solutions with the environment and climate. With this, awareness for the responsibility of an engineer's own actions are emphasized and the potential extra of the different solutions presented clearly. Within the framework of the exercise the students learn the use of the specialised software stability of the different solutions presented clearly. Within the framework of the exercise the students learn the use of the specialised software stability and development of power plant cycles. The students present their results orally and afterwards ask questions and get feedback. The course work has a positive effect on the students figrade. |
| Literature | Skripte Kalide: Kraft- und Arbeitsmaschinen Thomas, H.J.: Thermische Kraftanlagen. Springer-Verlag, 1985 Strauß, K.: Kraftwerkstechnik. Springer-Verlag, 2006 Kugeler und Phlippen: Energietechnik. Springer-Verlag, 1990 T. Bohn (Hrsg.): Handbuchreihe Energie, Band 7: Gasturbinenkraftwerke, Kombikraftwerke Heizkraftwerke und Industriekraftwerke, Technischer Verlag Resch / Verlag TÜV Rheinland |



| Module M1022: Reciprocating Machin | ery |
|------------------------------------|-----|
|------------------------------------|-----|

| Courses | | | |
|---|---|-------------|------------------|
| Title | Тур | Hrs/wk | СР |
| Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Lecture Engines (L0633) | | 1 | 1 |
| Fundamentals of Reciproca Engines (L0634) | Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Recitation Section (large) Engines (L0634) | | 1 |
| Internal Combustion Engine | · | 2 | 2 |
| Internal Combustion Engines | S I (L0639) Recitation Section (large) | 1 | 2 |
| Module Responsible | Prof. Christopher Friedrich Wirz | | |
| Admission Requirements | None | | |
| Recommended Previous Knowledge | Thermodynamics, Mechanics, Machine Elements | | |
| Educational Objectives | After taking part successfully, students have reached the following learning | results | |
| Professional | | | |
| Competence | | | |
| Knowledge | As a result of the part module "Fundamentals of Reciprocating Machinery", the students are able to reflect fundamentals regarding power and working machinery and describe the qualitative and quantitative correlations of operating methods and efficiencies of multiple types of engines, compressors and pumps. They are able to utilize technical terms and parameters as well as aspects regarding the development of power density and efficiency, furthermore to give an overview of charging systems, fuels and emissions. The students are able to select specific types of machinery and assess design related and operational problems. As a result of the part module "Internal Combustion Engines I", the students are able reflect and utilize the state-of-the-art regarding efficiency limits. In addition, they are able to utilize their knowledge of design, mechanical and thermodynamic characteristics and the approach of similarity. They are able to explain, assess and develop engines as well as charging systems. Detailed knowledge is present regarding computer-aided process design. | | |
| Skills | The students are skilled to employ basic and detail knowledge regarding reciprocating machinery their selection and operation. They are further able to assess, analyse and solve technical and operational problems and to perform mechanical and thermodynamic design. | | |
| Personal Competence | | | |
| Social Competence | The students are able to communicate and cooperate in a professional machinery design and application. | environmer | t in the field o |
| Autonomy | The widespread scope of gained knowledge enables the students to handle situations in their future profession independently and confidently. | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | |
| Credit points | ,—————————————————————————————————————— | | |
| Studienleistung | | | |
| | Written exam | | |
| Examination duration and scale | 120 min | | |
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Mechanisms: Compulsory General Engineering Science (German program, 7 semester): Specialisation Focus Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanisms | on Mechanic | al Engineerin |



Energy Systems: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Energy Systems: Compulsory
Mechanical Engineering: Specialisation Energy Systems: Compulsory

| Course L0633: Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines | | |
|---|---|--|
| Тур | Lecture | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Christopher Friedrich Wirz | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Verbrennungsmotoren Historischer Rückblick Einteilung der Verbrennungsmotoren Arbeitsverfahren Vergleichsprozesse Arbeit, Mitteldrücke, Leistungen Arbeitsprozess des wirklichen Motors Wirkungsgrade Gemischbildung und Verbrennung Motorkennfeld und Betriebskennlinien Abgasentgiftung Gaswechsel Aufladung Kühl- und Schmiersystem Kräfte im Triebwerk Kolbenverdichter Thermodynamik des Kolbenverdichters Einteilung und Verwendung Kolbenpumpen Prinzip der Kolbenpumpen Einteilung und Verwendung | |
| Literature | A. Urlaub: Verbrennungsmotoren W. Kalide: Kraft- und Arbeitsmaschinen | |
| | I | |

| Course L0634: Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines | | |
|---|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Christopher Friedrich Wirz | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Course L0059: Internal Combustion Engines I | | |
|---|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Wolfgang Thiemann | |
| Language | DE | |
| Cycle | SoSe | |
| Content | The beginnings of engine development Design of of motors Real process calculation Charging methods Kinematics of the crank mechanism Forces in the engine | |
| Literature | Vorlesungsskript Übungsaufgaben mit Lösungsweg Literaturliste | |

| Course L0639: Internal Combustion Engines I | |
|---|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Wolfgang Thiemann |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M0829: Fo | undations of Management | | | |
|--|--|------------------------------------|---------|--------|
| Courses | | | | |
| Title | | Typ | Hrs/wk | CP |
| Management Tutorial (L0882 Introduction to Management | • | Recitation Section (large) Lecture | 2 3 | 3 3 |
| Module Responsible | Prof. Christoph Ihl | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | | ess | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management explain the most important aspects of and goals in Management and name the most important aspects of entrepresental projects. | | | |
| Skills | Students are able to analyse business units with respect to different criteria (organization, objectives strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to • analyse Management goals and structure them appropriately • analyse organisational and staff structures of companies • apply methods for decision making under multiple objectives, under uncertainty and under risk • analyse production and procurement systems and Business information systems • analyse and apply basic methods of marketing • select and apply basic methods from mathematical finance to predefined problems • apply basic methods from accounting, costing and controlling to predefined problems | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a coherer | | | |
| Autonomy | Students are able to work in a team and to organize the team themselves to write a report on their project. | | | |
| | Independent Study Time 110, Study Time in | Lecture 70 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| | Subject theoretical and practical work | | | |
| Examination duration | | | | |



and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory

General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

Assignment for the Following Curricula

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:



Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

| Course L0882: Management Tutorial | | |
|-----------------------------------|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Christoph Ihl, Katharina Roedelius, Tobias Vlcek | |
| Language | DE | |
| Cycle | WiSe/SoSe | |
| Content | In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools. If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on self-selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the business knowledge from the lecture should come to practical use. The group projects are guided by a mentor. | |
| Literature | Relevante Literatur aus der korrespondierenden Vorlesung. | |



| urse L0880: Introduct | ion to Management | | | |
|-----------------------|---|--|--|--|
| | Lecture | | | |
| Hrs/wk | 3 | | | |
| СР | 3 | | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | | |
| Lecturer | Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona | | | |
| Language | DE | | | |
| Cycle | WiSe/SoSe | | | |
| Content | Introduction to Business and Management, Business versus Economics, relevant areas i Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects | | | |
| Literature | Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttga 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006. | | | |



| 0 | | | | |
|---|---|---|---------------|--------------------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | CP |
| Power Industry (L0316) | | Lecture | 1 | 1 |
| Energy Systems and Energy | y Industry (L0315) | Lecture | 2 | 2 |
| Renewable Energy (L0313) | | Lecture | 2 | 2 |
| Renewable Energy (L1434) | | Recitation Section (small) | 1 | 1 |
| Module Responsible | Prof. Martin Kaltschmitt | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | none | | | |
| Educational Objectives | After taking part successfully, students have r | eached the following learning | results | |
| Professional Competence | | | | |
| · | With completion of this module, the studen | ts can provide an overview | of character | istics of energ |
| Knowledge | systems and their economic efficiency. They can explain the issues occurring in this context. Furthermore, they can explain details of power generation, power distribution and power trading wih regard to subject-related contexts. The students can explain these aspects, which are applicable to many energy systems in general, especially for renewable energy systems and critical discuss them. Furthermore, the students can explain the environmental benefits from the use of such systems. | | | |
| Skills | Students are able to apply methodologies for detailed determination of energy demand or energy production for various types of energy systems. Furthermore, they can evaluate energy systems technically, environmentally and economically and design them under certain given conditions. Therefore, they can choose the necessary subject-specific calculation rules, also for not standardized solutions of a problem. The students are able to explain questions and possible approaches to its processing from the field of | | | |
| Davagnal Compatance | renewable energies orally and to put them th | em into the right context. | | |
| Personal Competence | | | | |
| Social Competence | The students are able to analyze suitable to economical and ecological criteria under sus contribution to a more sustainable power supports. | stainability aspects. This allow | | |
| Autonomy | Students can independently exploit sources and transform it to new questions. | , acquire the particular knowle | edge about | the subject are |
| Workload in Hours | Independent Study Time 96, Study Time in Le | ecture 84 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| | Written exam | | | |
| Examination duration | | | | |
| and scale Assignment for the Following Curricula | General Engineering Science (German Engineering: Compulsory General Engineering Science (German Enviromental Engineering: Compulsory General Engineering Science (German programmental Engineering Science (German programmental Engineering: Compulsory Energy and Environmental Engineering: Compulsory General Engineering Science (English Engineering: Compulsory | program, 7 semester): Sram, 7 semester): Specialisation: Compulsory | pecialisation | n Energy an cal Engineering |



General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Elective Compulsory

| Course L0316: Power Inc | dustry |
|-------------------------|---|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Martin Kaltschmitt, Prof. Andreas Wiese |
| Language | DE |
| Cycle | SoSe |
| Content | Electrical energy in the energy system Demand and use of electrical energy (households, industry, "new" buyers (including emobility)) Electricity generation electricity generation technologies using fossil fuels and their characteristics combined heat and power technologies and their production characteristics electricity generation from renewable energy technologies and their characteristics Power distribution "classic" distribution of electrical energy challenges of fluctuating electricity generation by distributed systems (electricity market, electricity stock exchange, emissions trading) District heating industry Legal and administrative aspects Energy Act support instruments for renewable energy CHP Act Cost and efficiency calculation |
| Literature | Folien der Vorlesung |

| Course L0315: Energy S | systems and Energy Industry |
|------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Martin Kaltschmitt |
| Language | DE |
| Cycle | SoSe |
| Content | Energy: development and significance Fundamentals and basic concepts Energy demand and future trends (heat, electricity, fuels) Energy reserve and sources Cost and efficiency calculation Final and effective energy from petroleum, natural gas, coal, uranium and other Legal, administrative and organizational aspects of energy systems Energy systems as a permanent optimization task |
| Literature | Kopien der Folien |



| Course L0313: Renewable Energy | | |
|--------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Martin Kaltschmitt | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | introduction solar energy for heat and power generation wind power for electricity generation hydropower for electricity generation ocean energy for electricity generation geothermal energy for heat and electricity generation | |
| Literature | Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - System technik, Wirtschaft lichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007 | |

| Course L1434: Renewak | ole Energy |
|-----------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Martin Kaltschmitt |
| Language | DE/EN |
| Cycle | SoSe |
| Content | Students work on different tasks in the field of renewable energies. They present their solutions in the exercise lesson and discuss it with other students and the lecturer. Possible tasks in the field of renewable energies are: Solar thermal heat Concentrating solare power Photovoltaic Windenergie Hydropower Heat pump Deep geothermal energy |
| Literature | Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Erneuerbare Energien - System technik, Wirtschaft lichkeit, Umweltaspekte; Springer, Berlin, Heidelberg, 2006, 4. Auflage Kaltschmitt, M.; Streicher, W.; Wiese, A. (Hrsg.): Renewable Energy - Technology, Economics and Environment; Springer, Berlin, Heidelberg, 2007 |



Focus Aircraft Systems Engineering

The area of specialization "Aircraft System Engineering" prepares participating students for diverse kind of professions in the field of aviation and related industries. Students learn how to use typical methods of systems engineering as well as the application of modern, computer-based techniques for system design, analysis and evaluation. Furthermore required knowledge from different fields of aviation including aircraft systems and air transportation system is discussed.

Additionally students get insight into current research activities, e.g. in the area of fuel cells and electrical energy supply, actuators, avionics systems and software or hydraulic energy supply.

| Module M0597: Ad | Ivanced Mechanical Engineer | ring Design | | |
|--|---|-------------------------------------|-------------|-----------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Advanced Mechanical Engir | | Lecture | 2 | 2 |
| Advanced Mechanical Engir | | Recitation Section (large) | 2 | 1 |
| Advanced Mechanical Engir Advanced Mechanical Engir | | Lecture Recitation Section (large) | 2 | 2 1 |
| Module Responsible | | | | |
| Admission Requirements | | | | |
| Recommended Previous Knowledge | Fundamentals of Mechanical En Mechanics Fundamentals of Materials Scier Production Engineering | | | |
| Educational Objectives | After taking part successfully, students h | ave reached the following learning | results | |
| Professional | | | | |
| Competence Knowledge | After passing the module, students are able to: • explain complex working principles and functions of machine elements and of basic elements of fluidics | | | |
| Skills | accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem colving). | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to discuss methods. | technical information in the lectur | re supporte | d by activating |
| Autonomy | Students are able to independently deepen their acquired knowledge in exercises. Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures. | | | |
| Workload in Hours | Independent Study Time 68, Study Time | e in Lecture 112 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| | | | | |



| Examination | Written exam |
|--------------------------------|---|
| Examination duration and scale | 120 |
| and scale | Constant Familia and a Calendar (Common and annual). Constant of the Machanital Familia is 5 |
| | General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory |
| | General Engineering Science (German program): Specialisation Mechanical Engineering, Focus |
| | Aircraft Systems Engineering: Compulsory |
| | General Engineering Science (German program): Specialisation Mechanical Engineering, Focus |
| | Materials in Engineering Sciences: Compulsory |
| | General Engineering Science (German program): Specialisation Mechanical Engineering, Focus |
| | Mechatronics: Compulsory |
| | General Engineering Science (German program): Specialisation Mechanical Engineering, Focus |
| | Product Development and Production: Compulsory |
| | General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Aircraft Systems Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Materials in Engineering Sciences: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Mechatronics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Theoretical Mechanical Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Biomechanics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Energy Systems: Compulsory |
| | General Engineering Science (English program): Specialisation Mechanical Engineering, Focus |
| Following Curricula | Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus |
| | Aircraft Systems Engineering: Compulsory |
| | General Engineering Science (English program): Specialisation Mechanical Engineering, Focus |
| | Materials in Engineering Sciences: Compulsory |
| | General Engineering Science (English program): Specialisation Mechanical Engineering, Focus |
| | Mechatronics: Compulsory |
| | General Engineering Science (English program): Specialisation Mechanical Engineering, Focus |
| | Product Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus |
| | Theoretical Mechanical Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Aircraft Systems Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Materials in Engineering Sciences: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Theoretical Mechanical Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Biomechanics: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Energy Systems: Compulsory |
| | Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory |
| | Traval Allolitecture. Gore qualification. Goripulsory |



| Course L0264: Advance | d Mechanical Engineering Design II |
|-----------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff |
| Language | DE |
| Cycle | SoSe |
| Content | Advanced Mechanical Engineering Design I & II Lecture • Fundamentals of the following machine elements: • Linear rolling bearings • Axes & shafts • Seals • Clutches & brakes • Belt & chain drives • Gear drives • Epicyclic gears • Crank drives • Sliding bearings • Elements of fluidics Exercise • Calculation methods of the following machine elements: • Linear rolling bearings • Axes & shafts • Clutches & brakes • Belt & chain drives • Belt & chain drives • Gear drives • Belt & chain drives • Gear drives • Epicyclic gears • Crank gears • Sliding bearings |
| Literature | Calculations of hydrostatic systems (fluidics) Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. |



| Course L0265: Advanced Mechanical Engineering Design II | | | |
|---|--|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | | |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |



| ourse L0262: Advanced Mechanical Engineering Design I | | | | | |
|---|---|--|--|--|--|
| Тур | Lecture | | | | |
| Hrs/wk | 2 | | | | |
| СР | 2 | | | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | | | |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff | | | | |
| Language | DE | | | | |
| Cycle | WiSe | | | | |
| | Advanced Mechanical Engineering Design I & II | | | | |
| Content | • Fundamentals of the following machine elements: • Linear rolling bearings • Axes & shafts • Seals • Clutches & brakes • Belt & chain drives • Gear drives • Epicyclic gears • Crank drives • Sliding bearings • Elements of fluidics Exercise • Calculation methods of the following machine elements: • Linear rolling bearings • Axes & shafts • Clutches & brakes • Belt & chain drives • Gear drives • Gear drives • Gear drives • Crank gears • Crank gears • Sliding bearings | | | | |
| Literature | Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F. Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. | | | | |



| Course L0263: Advanced Mechanical Engineering Design I | | | |
|--|--|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | | |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |



| Madula M0670, Cia | unals and Customs | | | | |
|--|---|--|--|---|--|
| Module M0672: Siç | gnals and Systems | | | | |
| Courses | | | | | |
| Title | | Тур | Hrs/wk | CP | |
| Signals and Systems (L0432) Signals and Systems (L0433) | | Lecture Recitation Section (small) | 3 | 4 2 | |
| Module Responsible | Prof. Gerhard Bauch | | | | |
| Admission Requirements | INone | | | | |
| · | Mathematics 1-3 | | | | |
| | The modul is an introduction to the theory of covered by the moduls Mathematik 1-3 is exp (Fourier series, Fourier transform, Laplace transform). | ected. Further experience w | ith spectral | | |
| Educational Objectives | After taking part successfully, students have re | ached the following learning | results | | |
| Professional | | | | | |
| Competence Knowledge | The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are able to apply the fundamental transformations of continuous-time and discrete-time signals and systems. They can describe and analyse deterministic signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal. | | | | |
| Skills | The students are able to describe and analyse using methods of signal and system theory. important properties such as magnitude and puthe impact of LTI systems on the signal properties. | They can analyse and desig phase response, stability, line | n basic sys earity etc T | tems regarding | |
| Personal Competence | | | | | |
| Social Competence | The students can jointly solve specific problems. | | | | |
| Autonomy | The students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the lecture period by solving tutorial problems, software tools clicker system. | | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | | |
| Credit points | 6 | | | | |
| Studienleistung | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and scale | 19() min | | | | |
| | General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German Engeneering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German progra General Engineering Science (German progra Compulsory General Engineering Science (German progra Compulsory | m): Specialisation Process Em): Specialisation Bioproces program): Specialisation program): Specialisation program): Specialisation m): Specialisation Biomedica am, 7 semester): Specialisation gram, 7 semester): Specialisation m, 7 semester): Speci | ngineering: s Engineering Civil- and Mechanica al Engineerin tion Electric sation Com ation Proces on Bioproce | Compulsory ng: Compulsory Enviromenta Engineering ng: Compulsory al Engineering uputer Science as Engineering as Engineering as Engineering | |
| | General Engineering Science (German progra | iii, 7 semesier). Specialisalio | n wechanic | ai Engineening | |



Focus Biomechanics: Compulsory

Following Curricula

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Theoretical Mechanical Engineering: Compulsory Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

Assignment for the

General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



| Course L0432: Signals a | and Systems |
|-------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | |
| | Independent Study Time 78, Study Time in Lecture 42 |
| | Prof. Gerhard Bauch |
| Language Cycle | |
| Content | Basic classification and description of continuous-time and discrete-time signals and systems Concvolution Power and energy of signals Correlation functions of deterministic signals Linear time-invariant (LTI) systems Signal transformations: Fourier-Series Fourier Transform Laplace Transform Discrete-time Fourier Transform Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT) Z-Transform Analysis and design of LTI systems in time and frequency domain Basic filter types Sampling, sampling theorem Fundamentals of recursive and non-recursive discrete-time filters |
| Literature | T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004 K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag. B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997 J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002 S. Haykin, B. van Veen: Signals and systems. Wiley. Oppenheim, A.S. Willsky: Signals and Systems. Pearson. Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson. |



| Course L0433: Signals a | and Systems |
|-------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Gerhard Bauch |
| Language | DE/EN |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | | |
|-----------------------------------|--|--|------------------------------------|-------------|----------------|
| Title | | | Тур | Hrs/wk | СР |
| Advanced Mechanical Desi | gn Project (L0266) | | Project-/problem-based Learning | 4 | 6 |
| Module Responsible | Dr. Jens Schmidt | | | | |
| Admission Requirements | INone | | | | |
| Recommended Previous Knowledge | | jineering: Design nanical Engineering Desig | n | | |
| Educational Objectives | After taking part succes | sfully, students have reac | hed the following learning | results | |
| Professional Competence | | | | | |
| | After passing the modul | le, students are able to: | | | |
| | - | cedure for systematically I | nandling of | | |
| Knowledge | complex designdescribe workin | tasks , g principles, their use and | combination possibilities | | |
| | explain guidelin | es for designing for functi | on and manufacturing, | , | |
| | explain advance | ed use-oriented knowledg | e of machine elements. | | |
| | After passing the modul | | | | |
| | analyze complex tasks and develop principle solutions using sketches, convert principle solutions into a detailed design, | | | | |
| Skills | use methods to design and solve engineering design tasks systematically and solution | | | | |
| Okilis | oriented, | al documentation includir | ng all nococcary tochnical | drawings to | understand th |
| | create a technical documentation including all necessary technical drawings to understand the functions of the system, | | | | |
| | document calcu | lations of selected machir | e elements clearly and in | detail. | |
| Personal Competence | | | | | |
| | After passing the modul | le, students are able to: | | | |
| Social Competence | present and disc | cuss solutions and technic | cal drawings within groups | 3, | |
| | reflect the own results in the work groups of the course | | | | |
| | After passing the modu | le, students are able to: | | | |
| | independently | solve complex design | projects, while motivat | ina themse | lves. acquirin |
| Autonomy | necessary know | independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and selecting appropriate methods, | | | |
| | to independently solve problems. | | | | |
| Workload in Hours | Independent Study Tim | e 124, Study Time in Lect | ure 56 | | |
| Credit points | 6 | | | | |
| Studienleistung | Yes None | Form Attestation | Description | | |
| Examination | Written exam | | | | |
| Examination duration | 1180 | | | | |
| and scale | | Science (German progra | m): Specialisation Mech | anical Engi | ineering Foo |
| | Aircraft Systems Engine | eering: Compulsory | | | _ |
| | | Science (German progra | | anical Engi | ineering, Focu |
| | - | and Production: Compulso Science (German progra | ry .m): Specialisation Mech | anical Engi | ineering, Foci |
| | | | | | J, |
| | Theoretical Mechanical | Engineering: Compulsor cience (German program, | У | | |



Assignment for the Following Curricula

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Core qualification: Compulsory

| Course L0266: Advance | d Mechanical Design Project |
|-----------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| СР | 6 |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Lecturer | Dr. Jens Schmidt, Dr. Volkert Wollesen |
| Language | DE |
| Cycle | WiSe |
| | Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung. |
| Content | Getriebekonstruktion in Einzelarbeit Erarbeitung von Lösungsprinzipien Berechnung von Maschinenelementen Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten Erstellung einer ausführlichen Dokumentation Lösungsfindung Methodische Erarbeitung von prinzipiellen Lösungskonzepten Erstellen einer Dokumentation |
| Literature | Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen |



| Courses | | | | | |
|---|---|--|--|---|--|
| Simulation and Design of Me | echatronic Systems (L1822) echatronic Systems (L1823) echatronic Systems (L1824) | Typ Lecture Recitation Section (large) Practical Course | Hrs/wk 2 1 | CP 2 2 2 | |
| Module Responsible | 1 | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | I FIINGSTMANTSIC OF MACHANICE CONTROL THACK | and electrical engineering | | | |
| Educational Objectives | After taking part successfully, students have | e reached the following learning | results | | |
| Professional Competence | | | | | |
| Knowledge | Students are able to describe methods optimization of mechatronic systems. | and calculations for design, | modeling, | simulation and | |
| Skills | Students are able to apply modern algorith simulate and design simple systems and in | | | ney can identify | |
| Personal Competence | | | | | |
| Social Competence | Ctudente ave able to ward read ariented in | small mixed groups and present | results to ta | rget groups. | |
| | Students are able to recognize and improve knowledge deficits independently. | | | | |
| Autonomy | With instructor assistance, students are able to evaluate their own knowledge level and define further course of study. | | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | | |
| Credit points | 6 | | | | |
| Studienleistung | None | | | | |
| | Written exam | | | | |
| Examination duration and scale | 90 min | | | | |
| Assignment for the Following Curricula | | program): Specialisation Mechanologicalisation Mechanologicalisati | anical Enginanical Enginan Mechanical Enginanical Engi | neering, Focu neering, Focu cal Engineering cal Engineering cal Engineering neering, Focu neering, Focu neering, Focu cal Engineering | |



Mechanical Engineering: Specialisation Mechatronics: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory Mechatronics: Core qualification: Compulsory

| Course L1822: Simulation | on and Design of Mechatronic Systems | |
|--------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Uwe Weltin | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Mechatronic Design Modeling Model Identifikation Numerical Methods in simulation Applications and examples in Matlab® and Simulink® | |
| Literature | Skript zur Veranstaltung Weitere Literatur in der Veranstaltung | |

| Course L1823: Simulation | on and Design of Mechatronic Systems |
|--------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Uwe Weltin |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L1824: Simulation | ourse L1824: Simulation and Design of Mechatronic Systems | | |
|--------------------------|---|--|--|
| Тур | Practical Course | | |
| Hrs/wk | 1 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Prof. Uwe Weltin | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |



| After taking part successfully, stud | Typ Lecture Recitation Section (small) stems in time and frequency domain, Lap dents have reached the following learning | | CP 4 2 |
|--|---|--|--|
| Prof. Herbert Werner None Representation of signals and syn | Recitation Section (small) | 2 place transfor | 2 |
| None Representation of signals and sy | | | m |
| Representation of signals and sy | | | rm |
| After taking part successfully, stud | | | m |
| | dents have reached the following learning | g results | |
| | | | |
| | | | |
| Students can represent dynamic system behavior in time and frequency domain, and can ir particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties ir terms of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequency response They can explain issues arising when controllers designed in continuous time domain are implemented digitally | | | |
| vice versa They can simulate and as They can design PID cont They can analyze and frequency response techn They can calculate discrand use it for digital imple | ssess the behavior of systems and control trollers with the help of heuristic (Ziegler-Neurons) synthesize simple control loops with the hiques rete-time approximations of controllers comentation | loops Nichols) tunir the help of designed in | ng rules root locus an continuous-tim |
| | | | |
| | ups to jointly solve technical problems, | and experim | nentally validat |
| Students can obtain information experiment guides) and use it wh | nen solving given problems. | | |
| ndependent Study Time 124 Stu | udy Time in Lecture 56 | | |
| | ady Time in Leolule 30 | | |
| | | | |
| | | | |
| | | | |
| | They can explain the dy terms of frequency response They can explain the Nyq They can explain the role They can explain the waresponse They can explain issues implemented digitally Students can transform in vice versa They can simulate and as They can design PID conton They can analyze and frequency response techn They can calculate discrand use it for digital imple They can use standard so tasks Students can work in small grotheir controller designs Students can obtain information experiment guides) and use it where they can assess their knowledge and they can | They can explain the dynamics of simple control loops and inte terms of frequency response and root locus They can explain the Nyquist stability criterion and the stability mar They can explain the role of the phase margin in analysis and synt They can explain the way a PID controller affects a control loor response They can explain issues arising when controllers designed in complemented digitally Students can transform models of linear dynamic systems from the vice versa They can simulate and assess the behavior of systems and control They can design PID controllers with the help of heuristic (Ziegler-Interventage) They can analyze and synthesize simple control loops with the frequency response techniques They can calculate discrete-time approximations of controllers of and use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Sintasks Students can work in small groups to jointly solve technical problems, their controller designs Students can obtain information from provided sources (lecture note experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby contended on the study Time 124, Study Time in Lecture 56 None Written exam Ageneral Engineering Science (German program): Core qualification: Com | They can explain the dynamics of simple control loops and interpret dynam terms of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived They can explain the role of the phase margin in analysis and synthesis of cont They can explain the way a PID controller affects a control loop in terms response They can explain issues arising when controllers designed in continuous ti implemented digitally Students can transform models of linear dynamic systems from time to frequency evice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tunin They can analyze and synthesize simple control loops with the help of frequency response techniques They can calculate discrete-time approximations of controllers designed in and use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for catasks Students can work in small groups to jointly solve technical problems, and experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learn independent Study Time 124, Study Time in Lecture 56 None Written exam |



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

General Engineering Science (English program): Core qualification: Compulsory

Assignment for the General Englowing Curricula Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory



Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective

Compulsory

Process Engineering: Core qualification: Compulsory

| Course L0654: Introduct | ion to Control Systems |
|-------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. Herbert Werner |
| Language | DE |
| Cycle | WiSe |
| | Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle Root locus techniques |
| Content | Root locus plots Root locus design of PID controllers Frequency response techniques Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control |
| | Time delay systems Root locus and frequency response of time delay systems Smith predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course |
| Literature | Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems' Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010 |



| Course L0655: Introduct | tion to Control Systems |
|-------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Herbert Werner |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | | |
|-----------------------------------|--|--|--|---|---|
| Title Computer Engineering (L032 | | | Typ Lecture | Hrs/wk | CP 4 |
| Computer Engineering (L032 | <u>, </u> | | Recitation Section (small) | 1 | 2 |
| Module Responsible Admission | Prof. Heiko Falk | | | | |
| Requirements | None | | | | |
| Recommended Previous Knowledge | examination according to 1. Upon a passed marks due to the respectively, up to | etion of the labs will to the following rules: module examination, e successful labs, suc to the next-better grade | the student is granted a that the examination's made. | oonus on the arks are lifte | e examination' |
| Educational Objectives | After taking part success | fully, students have re | ached the following learning | results | |
| Professional Competence | | | | | |
| Competence | This module deals with | the foundations of the | functionality of computing | systems It co | overs the laver |
| Knowledge | from the assembly-level programming down to gates. The module includes the following topics: Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesi combinational networks Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architectur pipelining Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-poi connections, busses | | | | |
| Skills | structure and the physic specific and individual of They are able to distin computing systems - from After successful complete between a physical co- understand the consequal | cal composition of cor- computers can be built nguish between and m gates and circuits up etion of the module, to imputer system and dences that the executive ly language down to | the architect's perspective, inputer systems. The studer to based on a collection of fecto explain the different also to complete processors. The students are able to just the software executed on ion of software has on the legates. This way, they will be on an entire system's perspective. | nts can analy ew and simp postraction land dge the inter- it. In partice nardware-ce be enabled | yze, how highly le components yers of today! erdependencies ular, they shain tric abstraction to evaluate the |
| Personal Competence | | | | | |
| Social Competence | Students are able to solv | ve similar problems ald | one or in a group and to pres | sent the resu | Its accordingly. |
| Autonomy | Students are able to accomit other classes. | quire new knowledge | from specific literature and | to associate | this knowledge |
| Workload in Hours | Independent Study Time | 124, Study Time in Le | ecture 56 | | |
| Credit points | 6 | | | | |
| | Compulsory Bonus | Form | Description | | |



| Examination duration and scale | 90 minutes, contents of course and labs | | |
|--------------------------------|---|--|--|
| | General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: | | |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory | | |
| | General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory | | |
| | General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory | | |
| | General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: | | |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and | | |
| | Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: | | |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory | | |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory | | |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory | | |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, | | |
| | Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, | | |
| | Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, | | |
| | Focus Energy Systems: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory | | |
| | General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: | | |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory | | |
| | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory | | |
| | General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory | | |
| | General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: | | |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental | | |
| | Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: | | |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory | | |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory | | |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory | | |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, | | |
| | Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, | | |
| | Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, | | |
| | Focus Energy Systems: Compulsory | | |



Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory

| Course L0321: Compute | r Engineering |
|-----------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Heiko Falk |
| Language | DE |
| Cycle | WiSe |
| Content | Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output |
| Literature | A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. |

| Course L0324: Computer Engineering | |
|------------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Heiko Falk |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | | |
|--|--|---|--|---------------|----------------|
| Title | | | Тур | Hrs/wk | СР |
| CAE-Team Project (L0271) | | | Project-/problem-based Learning | 2 | 2 |
| Development of Lightweight Integrated Product Develop | • , , | | Lecture Lecture | 2 | 2 |
| Module Responsible | Prof. Dieter Krause | | | | |
| Admission Requirements | INone | | | | |
| | Advanced Knowledge ab | oout engineering design: | | | |
| D | Fundamentals of Mechar | nical Engineering Desigr | 1 | | |
| Recommended Previous Knowledge | Mechanical Engineering | : Design | | | |
| | Advanced Mechanical Er | ngineering Design | | | |
| Educational Objectives | After taking part successf | fully, students have reach | ned the following learning | results | |
| Professional | | | | | |
| Competence | After completing the mod | lule, students are capable | e of: | | |
| Knowlodgo | | · | | EEM Systom | 0 |
| Knowledge | | | AD-Systems, PDM- and I CAE-Systems in the produ | - | |
| | | | | | |
| | After completing the mod | lule, students are able to | : | | |
| | 13 13 p | , | | | |
| Skills | a a al ala different | LOAD and DDM O also | and the second state of the second | | |
| | evaluate dillerent | t CAD- and PDM-Systen emes and product structu | ns with regards to the de Iring | sired require | ements such a |
| | | | PDM- and/or FEM-Syster | ns with share | ed workload |
| | | | | | |
| Personal Competence | | | | | |
| · | After completing the mod | lule, students are able to | : | | |
| 0 | To develop a pro | eject plan and allocate w | ork appropriate work pa | ckages in th | ne framework o |
| Social Competence | group discussions | S | | | |
| | Present project re | esults as a team for instar | ice in a presentation | | |
| | Students are capable of: | | | | |
| Autonomy | independently ad | lapt to a CAE-Tool and co | omplete a given practical | task with it | |
| Workload in Hours | Independent Study Time | 96, Study Time in Lectur | re 84 | | |
| Credit points | 6 | | | | |
| | Compulsory Bonus | Form | Description | | |
| Studienleistung | Yes 20 % | Subject theoretica practical work | I and CAE-Teamproje Ausarbeitung | ekt inkl. | Vortrag und |
| Examination | Written exam | | | | |
| Examination duration and scale | 90 | | | | |
| | _ | | m): Specialisation Mech | anical Engi | neering, Focu |
| | Aircraft Systems Enginee General Engineering So | | m): Specialisation Mech | ianical Engi | neering Foo |
| | Product Development an | | | ui Engi | |



| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory |
|---------------------|---|
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory |
| Assignment for the | General Engineering Science (English program): Specialisation Mechanical Engineering, Focus |
| Following Curricula | Aircraft Systems Engineering: Compulsory |
| Following Curricula | General Engineering Science (English program): Specialisation Mechanical Engineering, Focus |
| | Product Development and Production: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Aircraft Systems Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory |
| | Mechanical Engineering: Specialisation Product Development and Production: Compulsory |
| | Mechanical Engineering: Specialisation Aircraft Systems Engineering: Compulsory |
| | Product Development, Materials and Production: Technical Complementary Course Core Studies: |
| | Elective Compulsory |

| Course L0271: CAE-Team Project | | |
|--------------------------------|--|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Dieter Krause | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Practical Introduction in the used software systems (Creo, Windchill, Hyperworks) Team formation, allocation of tasks and generation of a project plan Collective creation of one product out of CAD models supported by FEM calculations and PDM system Manufacturing of selected parts using 3D printer Presentation of results Description Part of the module is a project based team orientated practical course using the PBL method. In this course, students learn the handling of modern CAD, PDM and FEM systems (Creo, Windchill and Hyperworks). After a short introduction in the applied software systems, students work in teams on a task during the semester. The aim is the development of one product out of several CAD parts models using a PDM system including FEM calculations of selected parts and 3D printing of parts. The developed product must be presented in a joint presentation. | |
| Literature | - | |



| Course L0270: Development of Lightweight Design Products | | | |
|--|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Dieter Krause, Prof. Benedikt Kriegesmann | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Lightweight design materials Product development process for lightweight structures Dimensioning of lightweight structures | | |
| Literature | Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005. Klein, B., "Leichtbau-Konstruktion", Vieweg & Sohn, Braunschweig, 1989. Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012. Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986. | | |

| Course L0269: Integrate | d Product Development I |
|-------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause |
| Language | DE |
| Cycle | SoSe |
| Content | Introduction to Integrated Product Development 3D CAD -Systems and CAD interfaces Administration of part lists / PDM systems PDM in different industries Selection of CAD-/PDM Systems Simulation Construction methods Design for X |
| Literature | Ehrlenspiel, K.: Integrierte Produktentwicklung, München, Carl Hanser Verlag Lee, K.: Principles of CAD / CAM / CAE Systems, Addison Wesles Schichtel, M.: Produktdatenmodellierung in der Praxis, München, Carl Hanser Verlag Anderl, R.: CAD Schnittstellen, München, Carl Hanser Verlag Spur, G., Krause, F.: Das virtuelle Produkt, München, Carl Hanser Verlag |



| Module M0767: Ae | ronautical Systems | | | |
|---|--|---|-----------------------|-------------------|
| Courses | | | | |
| Title Fundamentals of Aircraft Sy Fundamentals of Aircraft Sy Air Transportation Systems Air Transportation Systems | stems (L0742) (L0591) | Typ Lecture Recitation Section (small) Lecture Recitation Section (large) | Hrs/wk 2 1 2 | CP 2 1 2 1 |
| | Prof. Frank Thielecke | | | |
| Admission Requirements | | | | |
| Recommended Previous Knowledge | Basics of mathematics, mechanics and thermody | namics | | |
| Educational Objectives | After taking part successfully, students have reach | ned the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Students get a basic understanding of the structure and design of an aircraft, as well as an overview of the systems inside an aircraft. In addition, a basic knowledge of the relationchips, the key parameters, roles and ways of working in different subsystems in the air transport is acquired. | | | |
| Skills | Due to the learned cross-system thinking students can gain a deeper understanding of different system concepts and their technical system implementation. In addition, they can apply the learned methods for the design and assessment of subsystems of the air transportation system in the context of the overall system. | | | |
| Personal Competence | | | | |
| Social Competence | Students are made aware of interdisciplinary com | munication in groups. | | |
| Autonomy | Students are able to independently analyze different system concepts and their technical implementation as well as to think system oriented. | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 | | | |
| Credit points | 6 | | | |
| Studienleistung | | | | |
| | Written exam | | | |
| Examination duration and scale | 150 min | | | |
| | General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory Logistics and Mobility: Specialisation Logistics and Mobility: Elective Compulsory | | | |

Mechanical Engineering: Specialisation Aircraft Systems Engineering: Compulsory



| Course L0741: Fundame | entals of Aircraft Systems |
|-----------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Frank Thielecke |
| Language | DE |
| Cycle | SoSe |
| Content | Development of aircrafts, fundamentals of flight physics, propulsion systems, analysis of ranges and loads, aircraft-structures and materials Hydraulic and electrical power systems, landing gear systems, flight-control and high-lift systems, air conditioning systems |
| Literature | - Shevell, R. S.: Fundamentals of Flight - TÜV Rheinland: Luftfahrtzeugtechnik in Theorie und Praxis - Wild: Transport Category Aircraft Systems |

| Course L0742: Fundamentals of Aircraft Systems | | |
|--|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Frank Thielecke | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Course L0591: Air Trans | portation Systems | | |
|-------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Volker Gollnick | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Air transport as part of the global transportation system Legal basis of air transportation Safety and security aspects Aircraft basics The role of the aircraft amnufacturer The role of the aircraft operator Airport operation The principles of air traffic management Environmental aspects of air transportation Future perspectives of air transport | | |
| Literature | V. Gollnick, D. Schmitt: "Air Transport System", Springer-Verlag, ISBN 978-3-7091-1879-5 H. Mensen: "Handbuch der Luftfahrt", Springer-Verlag, 2003 K. Hünecke: "Die Technik des modernen Verkehrsflugzeugs", Motorbuch-Verlag, 2000, ISBN 3-613-01895-0 I. Moir, A. Seabridge: "Aircraft Systems", AIAA Education Series, 2001, ISBN 1-56347-506-5 D.P. Raymer: "Aircraft Design - A Conceptual Approach", AIAA Education Series, 2006, ISBN 1-56347-281-3 N. Ashford: "Airport Operations", McGraw-Hill, 1997, ISBN0-07-003077-4 P. Maurer: "Luftverkehrsmanagement", Oldenbourg-Verlag, ISBN 3-486-27422-8 H. Mensen: "Moderne Flugsicherung", Springer-Verlag, 2004, ISBN 3-540-20581-0 | | |

| Course L0816: Air Transportation Systems | | | |
|--|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | ndependent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Volker Gollnick | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Practical exercises to understand • aircraft movement in wind conditions • aircraft performance analyses • radio navigation prinicples Objective: Understanding and application of principle methods to practical aviation problems | | |
| Literature | Hünnecke: Das moderne Verkehrsflugzeug von heute Flühr: Avionik und Flugsicherungstechnik | | |



| Module M0829: Fo | undations of Management | | | |
|--|--|---|---|---|
| Courses | | | | |
| Title | | Тур | Hrs/wk | CP |
| Management Tutorial (L0882 Introduction to Management | | Recitation Section (large) Lecture | 2 3 | 3 3 |
| Module Responsible | Prof. Christoph Ihl | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | | ss | | |
| Educational Objectives | After taking part successfully, students have re | eached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | describe and explain basic business supply chain management, organize management, innovation managemer. explain the relevance of planning an multiple objectives and uncertainty, Finance. state basics from accounting and cost. | conomics and Management and definitions from the field of Marand goals in Management are so functions as production, pation and human ressource at and marketing decision making in Busines and explain some basic marand and selected controlling marand and selected controlling marand | and the sunagement and name the procurement managements, esp. in sethods from ethods. | b-disciplines in most important and sourcing ent, information situations under mathematical |
| Skills | Students are able to analyse business units with respect to different criteria (organization, objectives strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to • analyse Management goals and structure them appropriately • analyse organisational and staff structures of companies • apply methods for decision making under multiple objectives, under uncertainty and under risk • analyse production and procurement systems and Business information systems • analyse and apply basic methods of marketing • select and apply basic methods from mathematical finance to predefined problems • apply basic methods from accounting, costing and controlling to predefined problems | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to work successfully in a team of student to apply their knowledge from the lece report on the project to communicate appropriately and to cooperate respectfully with their fell | ture to an entrepreneurship p | roject and v | write a coherer |
| Autonomy | Students are able to work in a team and to organize the team themselves to write a report on their project. | | | |
| | Independent Study Time 110, Study Time in L | ecture 70 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| | Subject theoretical and practical work | | | |
| Examination duration | | | | |



and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

Assignment for the Following Curricula

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:



Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

| Course L0882: Management Tutorial | | |
|-----------------------------------|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Christoph Ihl, Katharina Roedelius, Tobias Vlcek | |
| Language | DE | |
| Cycle | WiSe/SoSe | |
| Content | In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools. If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on self-selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the business knowledge from the lecture should come to practical use. The group projects are guided by a mentor. | |
| Literature | Relevante Literatur aus der korrespondierenden Vorlesung. | |



| ırse L0880: Introduct | ion to Management | | |
|-----------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 3 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | |
| Lecturer | Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrir Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona | | |
| Language | DE | | |
| Cycle | WiSe/SoSe | | |
| Content | Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects | | |
| Literature | Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgar 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006. | | |



Focus Materials in Engineering Sciences

In the specialization "materials in the engineering sciences" the graduates learn how to systematically and methodically analyze and understand fundamental materials-related phenomena. They have broad knowledge of the material science basics of structural and functional materials, including metals, polymers and ceramics. The graduates understand the impact of composition, processing, and service conditions on the material's behavior. Based on this understanding they can assess the suitability of materials for specific technological problems.

| Module M0597: Ad | Ivanced Mechanical Engineerii | na Desian | | |
|-----------------------------------|--|---|--------------|-----------------|
| module mossi. Ad | ivanoca Mconamoai Engineeni | ig besign | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Advanced Mechanical Engin | neering Design II (L0264) | Lecture | 2 | 2 |
| Advanced Mechanical Engin | | Recitation Section (large) | 2 | 1 |
| Advanced Mechanical Engin | | Lecture | 2 | 2 |
| Advanced Mechanical Engin | neering Design I (L0263) | Recitation Section (large) | 2 | 1 |
| Module Responsible | Prof. Dieter Krause | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have | ve reached the following learning | results | |
| Professional | | | | |
| Competence | | | | _ |
| Knowledge | explain complex working principles and functions of machine elements and of basic elements of fluidics, explain requirements, selection criteria, application scenarios and practical examples o complex machine elements, indicate the background of dimensioning calculations. | | | |
| Skills | After passing the module, students are ab accomplish dimensioning calculate transfer knowledge learned in the skills), recognize the content of technical evaluate complex designs, technical | ons of covered machine element e module to new requirements a drawings and schematic sketches | and tasks (p | oroblem solving |
| Personal Competence | | | | |
| Social Competence | Students are able to discuss ted methods. | chnical information in the lectu | re supporte | d by activating |
| Autonomy | Students are able to independently deepen their acquired knowledge in exercises. Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures. | | | |
| Workload in Hours | Independent Study Time 68, Study Time in | Lecture 112 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration | 120 | | | |



and scale

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Assignment for the Following Curricula

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory



| 00 =0=0 :: / (@ : @ :: 00 | d Mechanical Engineering Design II | |
|---------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff | |
| Language | DE | |
| Cycle | SoSe | |
| | Advanced Mechanical Engineering Design I & II | |
| Content | Fundamentals of the following machine elements: | |
| Literature | Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springe Vieweg, aktuelle Auflage. | |



| Course L0265: Advanced Mechanical Engineering Design II | |
|---|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Course L0262: Advance | d Mechanical Engineering Design I | | |
|-----------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | ndependent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff | | |
| Language | | | |
| Cycle | WiSe | | |
| Content | Advanced Mechanical Engineering Design I & II Lecture • Fundamentals of the following machine elements: • Linear rolling bearings • Axes & shafts • Seals • Clutches & brakes • Belt & chain drives • Epicyclic gears • Crank drives • Sliding bearings • Elements of fluidics Exercise • Calculation methods of the following machine elements: • Linear rolling bearings • Axes & shafts • Clutches & brakes • Belt & chain drives • Gear drives • Gear drives • Belt & chain drives • Gear drives • Gear drives • Epicyclic gears • Crank gears | | |
| | Sliding bearings Calculations of hydrostatic systems (fluidics) | | |
| Literature | Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. | | |



| Course L0263: Advanced Mechanical Engineering Design I | |
|--|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | |
|-------------------------------------|--|---|--|--|
| Fitle | | Tun | Hro/wk | СР |
| Title Signals and Systems (L043) | 2) | Typ Lecture | Hrs/wk 3 | 4 |
| Signals and Systems (L043 | | Recitation Section (small) | 2 | 2 |
| Module Responsible | Prof. Gerhard Bauch | | | |
| Admission | | | | |
| Requirements | None | | | |
| | Mathematics 1-3 | | | |
| | The modul is an introduction to the theory covered by the moduls Mathematik 1-3 is e (Fourier series, Fourier transform, Laplace tr | xpected. Further experience w | ith spectral | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | |
| Professional | | | | |
| Competence | <u>}</u> | | | |
| Knowledge | The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are able to apply the fundamental transformations continuous-time and discrete-time signals and systems. They can describe and analyse determinist signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal. | | | |
| Skills | The students are able to describe and analyse deterministic signals and linear time-invariant system using methods of signal and system theory. They can analyse and design basic systems regardin important properties such as magnitude and phase response, stability, linearity etc They can asses the impact of LTI systems on the signal properties in time and frequency domain. | | | |
| Personal Competence | | | | |
| Social Competence | The students can jointly solve specific proble | ems. | | |
| Autonomy | The students are able to acquire relevant information from appropriate literature sources. They ca control their level of knowledge during the lecture period by solving tutorial problems, software tools clicker system. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in | Lecture 70 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| | | | | |
| <u>_</u> | Written exam | | | |
| Examination Examination duration | 90 min | | | |
| Examination | 90 min General Engineering Science (German prog | gram): Specialisation Computer | Science: Co | mpulsory |
| Examination Examination duration | 90 min General Engineering Science (German prog | gram): Specialisation Computer gram): Specialisation Process E gram): Specialisation Bioproces on program): Specialisation on program): Specialisation on program): Specialisation Biomedical gram, 7 semester): Specialisation gram, 7 semester): Specialisation or program, 7 semester): Specialisation program, | Science: Congineering: s Engineering: s Engineering: divil- and Mechanical al Engineering tion Electrical sation Compation Process | ompulsory Compulsory ng: Compulsor Enviromenta Engineering ng: Compulsor al Engineering uputer Science |



Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Mechatronics: Compulsory

Assignment for the

Following Curricula

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Theoretical Mechanical Engineering: Compulsory

Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



| Course L0432: Signals and Systems | | |
|-----------------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| СР | | |
| | Independent Study Time 78, Study Time in Lecture 42 | |
| Lecturer Language | Prof. Gerhard Bauch | |
| Cycle | | |
| Content | Basic classification and description of continuous-time and discrete-time signals and systems Concvolution Power and energy of signals Correlation functions of deterministic signals Linear time-invariant (LTI) systems Signal transformations: Fourier-Series Fourier Transform Laplace Transform Discrete-time Fourier Transform Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT) Z-Transform Analysis and design of LTI systems in time and frequency domain Basic filter types Sampling, sampling theorem Fundamentals of recursive and non-recursive discrete-time filters | |
| Literature | T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004 K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag. B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997 J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002 S. Haykin, B. van Veen: Signals and systems. Wiley. Oppenheim, A.S. Willsky: Signals and Systems. Pearson. Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson. | |



| Course L0433: Signals and Systems | |
|-----------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Gerhard Bauch |
| Language | DE/EN |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M0988: Structural Materials | | | | | |
|---|--|------------------------------|----------------|--------|--|
| Courses | | | | | |
| Title | | Тур | Hrs/wk | СР | |
| Fundamentals of Mechanical Properties of Materials (L1090) Welding Technology (L1123) | | Lecture Lecture | 2 3 | 3 3 | |
| | | Lecture | 3 | 3 | |
| | Prof. Claus Emmelmann | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | Fundamentals of Materials Science | | | | |
| Educational Objectives | After taking part successfully, students have | ve reached the following lea | arning results | | |
| Professional | | | | | |
| Competence | | | | | |
| Knowledge | The students get to know the principles that are responsible for the mechanical behaviour of metals. They acquire basic knowlegde in modelling of the materials behaviour. Furthermore, the students learn about the behaviour of metals under static and dynamic loads. The students get to know the most important welding technologies and the corresponding systems. They learn about the influence of welding on the materials and design. | | | | |
| Skills | The students know the mechanical properties of metals and the underlying principles. They are able to name the influencing factors on the welding behaviour of steel materials. The students are able to select between alloys according to the desired mechaincal properties and welability. They can distinguish between different welding techniques and select the suitable technique and system components for a defined application. They are able to dimension weld joints within design tasks. | | | | |
| Personal Competence | | | | | |
| Social Competence | none | | | | |
| Autonomy | none | | | | |
| Workload in Hours | Independent Study Time 110, Study Time | in Lecture 70 | | | |
| Credit points | 6 | | | | |
| Studienleistung | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and scale | 90 min | | | | |
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory Mechanical Engineering: Specialisation Materials in Engineering Sciences: Compulsory | | | | |



| Course L1090: Fundamentals of Mechanical Properties of Materials | | | |
|--|--|--|--|
| Typ Lecture | | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Norbert Huber, Dr. Erica Lilleodden | | |
| Language | EN | | |
| Cycle | SoSe | | |
| Content | Introduction and overview Bonding and crystallography, stress, strain, linear elasticity Plasticity of metallic materials Dislocations: Structure, stress, strain, strain energy Dislocations: Motion and forces Partial dislocations, dislocation interactions, jogs and kinks Strengthening mechanisms Introduction to modelling of materials behaviour, classification of phenomena Linear and nonlinear elasticity Plasticity, tensile loading, cyclic loading Viscoelasticity, effects of loading history, creep, relaxation Viscoplasticity, overstress, rate sensitivity of metallic materials Identification of material parameters | | |
| Literature | Hull and Bacon: Introduction to Dislocations (1984) G. Gottstein: Physik. Grundlagen der Materialk. (2001) N.Huber: Scriptum "Materialtheorie" Uni Karlsruhe (1998) P. Haupt: Cont. Mechanics and Theory of Materials (2002) | | |



| Course L1123: Welding | Technology | |
|-----------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | |
| Lecturer | Prof. Claus Emmelmann, Prof. Karl-Ulrich Kainer | |
| Language | DE | |
| Cycle | WiSe | |
| | phase transitions, phase diagrams and thermal activated processes fundamentals of steels, heat treatment applications for steels and time temperature transformation diagrams | |
| | - properties of weldable carbon and fine grained steels | |
| | - properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength steels | |
| | - structure and properties of non-ferrite metals (aluminum, titanium) | |
| | - NDT/DT Methods for materials and welds | |
| | - gas fusion welding, fundamentals of electric arc welding technologies | |
| Content | - structure and influence parameters for the welded joint | |
| | - submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas metal arc welding (MAG)/Plasma Welding | |
| | - resistance welding/ polymer welding/ hybrid-welding | |
| | - deposition welding | |
| | - electron beam welding/ laser beam welding | |
| | - weld joint designs and declarations | |
| | - computation methods for weld joint dimensioning | |
| | Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner H.: Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006. | |
| Literature | Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweißen, 3. Aufl., Berlin 2005. | |
| | Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit von Schweißkonstruktionen, 2. Aufl., Berlin 2002. | |
| | | |



| Module M0662: Numerical Mathematics I | | | | |
|--|---|--|--|--|
| Courses | | | | |
| Courses | | T | 11 | OR |
| Title Numerical Mathematics I (Li | 0417) | Typ Lecture | Hrs/wk 2 | CP 3 |
| Numerical Mathematics I (L | , | Recitation Section (small) | 2 | 3 |
| | Prof. Sabine Le Borne | , | | |
| Admission | | | | |
| Requirements | INone | | | |
| Recommended Previous Knowledge | II for Technomathematicians | udents (german or english) or Ar | nalysis & Lir | near Algebra I + |
| Educational Objectives | After taking part successfully, students have | e reached the following learning | results | |
| Professional Competence | | | | |
| | Students are able to | | | |
| Knowledge | name numerical methods for interproblems, nonlinear root finding programmer. repeat convergence statements for explain aspects for the practical exand storage complexitx. | oblems and to explain their core the numerical methods, | deas, | - |
| Skills | Students are able to implement, apply and compare numerical methods using MATLAB, justify the convergence behaviour of numerical methods with respect to the problem and solution algorithm, select and execute a suitable solution approach for a given problem. | | | |
| Personal Competence | | | | |
| | Students are able to | | | |
| Social Competence | work together in heterogeneously and background knowledge), exp practical aspects regarding the imp | lain theoretical foundations an | | |
| | Students are capable | | | |
| Autonomy | to assess whether the supporting individually or in a team, to assess their individual progess a | - | | |
| Workload in Hours | I Independent Study Time 124, Study Time i | n Lecture 56 | | |
| Credit points | | | | |
| Studienleistung | <u> </u> | | | |
| | Written exam | | | |
| Examination duration and scale | 190 minutes | | | |
| | General Engineering Science (German pro General Engineering Science (German Biomechanics: Compulsory General Engineering Science (German Materials in Engineering Sciences: Compu General Engineering Science (German pro General Engineering Science (German Compulsory | program): Specialisation Mechanisms: Specialisation Mechanisms program): Specialisation Biomedica | anical Engi anical Engi al Engineeri | neering, Focus neering, Focus ng: Compulsory |
| | I | | | |



General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory Assignment for the Electrical Engineering: Core qualification: Elective Compulsory **Following Curricula** General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory
Computational Science and Engineering: Core qualification: Compulsory

Computational Science and Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Process Engineering: Specialisation Process Engineering: Elective Compulsory

| Course L0417: Numeric | al Mathematics I |
|-----------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Sabine Le Borne, Dr. Patricio Farrell |
| Language | DE/EN |
| Cycle | WiSe |
| Content | Error analysis: Number representation, error types, conditioning and stability Interpolation: polynomial and spline interpolation Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, adaptive quadrature, difference formulas Linear systems: LU and Cholesky factorization, matrix norms, conditioning Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular value decomposition, regularization Eigenvalue problems: power iteration, inverse iteration, QR algorithm Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Quasi-Newton methods for systems |
| Literature | Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik für Ingenieure und Naturwissenschaftler, Springer |



| Course L0418: Numerical Mathematics I | |
|---------------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Sabine Le Borne, Dr. Patricio Farrell |
| Language | DE/EN |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M1009: Ma | nterial Science Laboratory | | | |
|-----------------------------------|---|---|--|--|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Companion Lecture for Mate | erials Science Laboratory (L1088) | Lecture | 2 | 2 |
| Material Science Laboratory | (L1235) | Practical Course | 4 | 4 |
| Module Responsible | Prof. Bodo Fiedler | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | none | | | |
| Educational Objectives | After taking part successfully, students have rea | ached the following lear | ning results | |
| Professional | | | | |
| Competence | | | | |
| Knowledge | Students are able to give a summary of the technical details of experiments in the area of materials sciences and illustrate respective relationships. They are capable of describing and communicating relevant problems and questions using appropriate technical language. They can explain the typical process of solving practical problems and present related results. | | | communicating |
| Skills | The students can transfer their fundamental kn practical problems. They identify and overcome in the context of material sciences. | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to cooperate in small groups in order to conduct experiments in the context of | | | |
| Autonomy | Students are capable of solving problems in the context of materials sciences using provided literature. They are able to fill gaps in as well as extent their knowledge using the literature and other sources provided by the supervisor. | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lec | ture 84 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 1,5 h written Exam (50%) covering the lesson | | | |
| _ | General Engineering Science (German prog Materials in Engineering Sciences: Compulsor, General Engineering Science (German prog Product Development and Production: Compul General Engineering Science (German prograt Focus Materials in Engineering Sciences: Com General Engineering Science (English prog Materials in Engineering Sciences: Compulsor, General Engineering Science (English prog Product Development and Production: Compul General Engineering Science (English prograt Focus Materials in Engineering Sciences: Com Mechanical Engineering: Specialisation Product Mechanical Engineering: Specialisation Materi Product Development, Materials and Product Elective Compulsory | y gram): Specialisation M sory m, 7 semester): Special spulsory gram): Specialisation M y gram): Specialisation M sory m, 7 semester): Special spulsory ct Development and Proals in Engineering Scie | Mechanical Engineration Mechanical Enginechanical E | neering, Focus cal Engineering, neering, Focus neering, Focus cal Engineering, lsory |



| Course L1088: Compani | ion Lecture for Materials Science Laboratory |
|-----------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Patrick Huber |
| Language | DE |
| Cycle | WiSe |
| Content | Physico-chemical backgrounds and fundamental experimental principles with regard to the following experiments, the topics to be addressed are indicated in brackets for each experiment: 1. Phase diagrams, heat treatment, hardness measurements (thermodynamics, elastic properties of solids) 2. notch impact test (elastic properties of solids) 3. Processes during the solidifaction of metals (thermodynamics and kinetics of solid-liquid phase transitions) 4. tensile test (elastic properties of solids) 5. Identificiation of polymers (polymer physics) 6. fiber-reinforced polymers (physical principles of composite materials) 7. Production and microstructure of ceramic materials (physico-chemical principles of ceramics) 8. Mechanical properties of ceramic materials (elastic properties of solids and composite materials) |
| Literature | William D. Callister und David G. Rethwisch, Materialwissenschaften und Werkstofftechnik, Wiley&Sons, Asia (2011) William D. Callister, Materials Science and Technology, Wiley& Sons, Inc. (2007) |

| Course L1235: Material | Course L1235: Material Science Laboratory | | |
|------------------------|---|--|--|
| Тур | Practical Course | | |
| Hrs/wk | 4 | | |
| СР | 4 | | |
| Workload in Hours | Independent Study Time 64, Study Time in Lecture 56 | | |
| Lecturer | Prof. Bodo Fiedler, Prof. Stefan Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | | | |
| Literature | Vorlesungsunterlagen Grundlagen der Werkstoffwissenschaft I & II | | |



| Courses | | | | |
|--|--|---------------------------------------|--------------|-------------|
| Title | | Тур | Hrs/wk | СР |
| Introduction to Control Syste Introduction to Control Syste | | Lecture Recitation Section (small) | 2 | 4 2 |
| Module Responsible | Prof. Herbert Werner | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Representation of signals and systems | in time and frequency domain, Lapl | ace transfor | rm |
| Educational Objectives | After taking part successfully, students | have reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequence response They can explain issues arising when controllers designed in continuous time domain are implemented digitally | | | |
| Skills | Students can transform models of linear dynamic systems from time to frequency domain and vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks | | | |
| Personal Competence | | | | |
| Social Competence | Students can work in small groups to their controller designs | | • | - |
| Autonomy | Students can obtain information fror experiment guides) and use it when so They can assess their knowledge in we | lving given problems. | | |
| Workload in Hours | I Independent Study Time 124, Study Tir | me in Lecture 56 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| | Written exam | | | |
| Examination duration and scale | | | | |
| Examination duration | | | - | nputer Scie |



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

General Engineering Science (English program): Core qualification: Compulsory

Assignment for the General Englowing Curricula Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory



Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective

Compulsory

Process Engineering: Core qualification: Compulsory

| _ | Lastina | | | |
|------------|---|--|--|--|
| | Lecture | | | |
| Hrs/wk | | | | |
| CP | | | | |
| | Independent Study Time 92, Study Time in Lecture 28 | | | |
| | Prof. Herbert Werner | | | |
| Language | | | | |
| Cycle | | | | |
| | Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability | | | |
| Content | Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle | | | |
| | Root locus techniques Root locus plots Root locus design of PID controllers | | | |
| | Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control | | | |
| | Time delay systems Root locus and frequency response of time delay systems Smith predictor | | | |
| | Digital control | | | |
| | Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers | | | |
| | Software tools | | | |
| | Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course | | | |
| Literature | Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic System Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, 2010 | | | |



| Course L0655: Introduction to Control Systems | |
|---|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Herbert Werner |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | | |
|-----------------------------------|--|--|---|-------------------------------|-----------------|
| Title Computer Engineering (L032 | | | Typ Lecture | Hrs/wk | CP 4 |
| Computer Engineering (L032 | | | Recitation Section (small) | 1 | 2 |
| Module Responsible Admission | Prof. Heiko Falk | | | | |
| Requirements | None | | | | |
| Recommended Previous Knowledge | examination according to 1. Upon a passed marks due to the respectively, up to | etion of the labs will to the following rules: module examination, the successful labs, such to the next-better grade. | the student is granted a be that the examination's made, and of 4,3 up to 4,0 is not be the student and the student is granted. | onus on the arks are lifte | e examination' |
| Educational Objectives | After taking part success | fully, students have rea | ched the following learning | results | |
| Professional Competence | | | | | |
| Knowledge | This module deals with the foundations of the functionality of computing systems. It covers the layer from the assembly-level programming down to gates. The module includes the following topics: Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesi combinational networks Sequential logic: Flip-flops, automata, systematic hardware design | | | | |
| Personal Competence | | | | | |
| Social Competence | Students are able to solv | ve similar problems alor | ne or in a group and to pres | ent the resul | ts accordingly. |
| Autonomy | Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. | | | | |
| Workload in Hours | Independent Study Time | 124, Study Time in Led | cture 56 | | |
| Credit points | 6 | | | | |
| | Compulsory Bonus | Form | Description | | |



| Examination duration and scale | 90 minutes, contents of course and labs |
|--------------------------------|---|
| | General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and |
| | Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Energy Systems: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory |
| | General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental |
| | Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory |
| | Focus Energy Systems: Compulsory |



Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory

| Course L0321: Computer Engineering | | |
|------------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| СР | 4 | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output | |
| Literature | A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. | |

| Course L0324: Computer Engineering | | |
|------------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M1005: En | hanced Fundamentals of Materia | ıls Science | | |
|--|--|--|-----------------------|-----------------|
| Courses | | | | |
| | eramics and Polymers (L1233) eramics and Polymers (L1234) letals (L1086) | Typ Lecture Recitation Section (large) Lecture | Hrs/wk 2 1 2 | CP 2 1 3 |
| Module Responsible | Prof. Gerold Schneider | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Module "Fundamentals of Materials Science" Module "Materials Science Laboratory" Module "Advanced Materials" | | | |
| Educational Objectives | After taking part successfully, students have r | eached the following learning | results | |
| Professional Competence Knowledge | The students are able to give an enhanced or in metals, polymers and ceramics: Atomic bo and mass transport, microstructure and corresponding technical terms. | nds, crystal and amorphous st | tructures, de | |
| Skills Personal Competence Social Competence Autonomy | The students are able to apply the appromentioned subjects. The students are capable to understand inde and polymers. They should be able to critally | pendently the structure and pi | ropeties of c | eramics, metals |
| Workload in Hours | Independent Study Time 110, Study Time in I | ecture 70 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 180 min | | | |
| | General Engineering Science (German program): Specialisation Mechanical Engineering, Focu Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Product Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focu Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Product Development and Production: Compulsory Mechanical Engineering: Specialisation Materials in Engineering Sciences: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory | | | |



| | Lastina |
|-------------------------|--|
| | Lecture |
| Hrs/wk | |
| CP Warkland in Hause | |
| | Independent Study Time 32, Study Time in Lecture 28 Prof. Gerold Schneider, Prof. Bodo Fiedler |
| Language | |
| Cycle | |
| Сусіе | 1. Einführung |
| | Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen vo Hochleistungskeramik 2. Pulverherstellung |
| | Einteilung der Pulversyntheseverfahren Der Bayer-Prozess zur Al2O3-Herstellung Der Acheson-Prozess zur SiC-Herstellung Chemical Vapour Deposition |
| | Pulveraufbereitung Mahltechnik Sprühtrockner |
| | 3. Formgebung |
| | Arten der Formgebung Pressen (0 - 15 % Feuchte) Gießen (> 25 % Feuchte) Plastische Formgebung (15 - 25 % Feuchte) |
| Content | 4. Sintern |
| | Triebkraft des Sinterns Effekt von gekrümmten Oberflächen und Diffusionswegen Sinterstadien des isothermen Festphasensinterns Herring scaling laws Heißisostatisches Pressen |
| | 5. Mechanische Eigenschaften von Keramiken |
| | Elastisches und plastisches Materialverhalten Bruchzähigkeit - Linear-elastische Bruchmechanik Festigkeit - Festigkeitsstreuung |
| | 6. Elektrische Eigenschaften von Keramiken |
| | Ferroelektische Keramiken |
| | Piezo-, ferroelektrische Materialeigenschaften Anwendungen |
| | Keramische lonenleiter |
| | lonische Leitfähigkeit Dotiertes Zirkonoxid in der Brennstoffzelle und Lambdasonde |
| | D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Application and Design, Elesevier |
| | D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992 |
| | W.D. Kingery, Introduction to Ceramics, John Wiley & Sons, New York, 1975 |
| | D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press |



Literature

Polymerwerkstoffe
Struktur und mechanische Eigenschaften G.W.Ehrenstein;
Hanser Verlag; ISBN 3-446-12478-0; ca. 20 €

Kunststoffphysik
W.Retting, H.M.Laun; Hanser Verlag; ISBN 3446162356; ca. 25 €

Werkstoffkunde Kunststoffe
G.Menges; Hanser Verlag; ISBN 3-446-15612-7; ca. 25 €

Kunststoff-Kompendium
A.Frank, K. Biederbick; Vogel Buchverlag; ISBN 3-8023-0135-8; ca.30 €

| Course L1234: Enhanced Fundamentals: Ceramics and Polymers | | |
|--|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Gerold Schneider, Prof. Bodo Fiedler | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Course L1086: Enhance | d Fundamentals: Metals |
|-----------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Jörg Weißmüller, Prof. Patrick Huber |
| Language | DE |
| Cycle | SoSe |
| Content | Enhanced Fundamentals of Metals: Introduction to phenomenological thermodynamics Elasticity Thermal materials behavior (heat capacity, thermal expansion) Conductors, semiconductors, isolators: conduction mechanisms and band structure Superconductors Dry corrosion Electrochemistry in the material sciences Wet corrosion Alloy corrosion Corrosion protection Stainless steel Battery materials Supercapacitors Fuel cells Materials for hydrogen storage Magnetism: phenomenology, Magnetometers, atomistics, micromagnetism Magnetic materials: applications |
| Literature | Vorlesungsskript |



| Module M0829: Fo | undations of Management | | | |
|---|--|--|---|---|
| Courses | | | | |
| Title | 0 | Typ | Hrs/wk | CP |
| Management Tutorial (L0882 Introduction to Management | | Recitation Section (large) Lecture | 2 | 3 3 |
| Module Responsible | Prof. Christoph Ihl | | | |
| Admission Requirements | INANA | | | |
| Recommended Previous Knowledge | Basic Knowledge of Mathematics and Busines | S | | |
| | After taking part successfully, students have re- | ached the following learning | results | |
| Professional Competence | | | | |
| | After taking this module, students know the im Management, from Planning and Organisatio and Controlling. In particular they are able to • explain the differences between Eco | n to Marketing and Innovati | on, and also | o to Investmen |
| Knowledge | Management and to name important de explain the most important aspects of a | efinitions from the field of Mar and goals in Management ar functions as production, p tion and human ressource and marketing decision making in Busine and explain some basic m | nagement nd name the procurement manageme ss, esp. in s lethods from | most importan and sourcing ent, information |
| Skills | Students are able to analyse business units with respect to different criteria (organization, objectives strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to • analyse Management goals and structure them appropriately • analyse organisational and staff structures of companies • apply methods for decision making under multiple objectives, under uncertainty and under risk • analyse production and procurement systems and Business information systems • analyse and apply basic methods of marketing • select and apply basic methods from mathematical finance to predefined problems • apply basic methods from accounting, costing and controlling to predefined problems | | | |
| Personal Competence | | | | |
| Social Competence | work successfully in a team of students to apply their knowledge from the lectureport on the project to communicate appropriately and to cooperate respectfully with their fello | | roject and w | rite a coheren |
| Autonomy | Students are able to work in a team and to organize the team to write a report on their project. | n themselves | | |
| | Independent Study Time 110, Study Time in Le | ecture 70 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| | Subject theoretical and practical work | | | |
| Examination duration | | | | |



and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

Assignment for the Following Curricula

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:



Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

| Course L0882: Management Tutorial | | |
|-----------------------------------|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Christoph Ihl, Katharina Roedelius, Tobias Vlcek | |
| Language | DE | |
| Cycle | WiSe/SoSe | |
| Content | In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools. If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on self-selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the business knowledge from the lecture should come to practical use. The group projects are guided by a mentor. | |
| Literature | Relevante Literatur aus der korrespondierenden Vorlesung. | |



| rse L0880: Introduct | ion to Management | | | |
|----------------------|--|--|--|--|
| Тур | Lecture | | | |
| Hrs/wk | 3 | | | |
| СР | 3 | | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | | |
| Lecturer | Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrir Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona | | | |
| Language | DE | | | |
| Cycle | WiSe/SoSe | | | |
| Content | Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects | | | |
| Literature | Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttga 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006. | | | |



Focus Mechatronics

In the focus "Mechatronics" students learn next to the knowledge and skills of mechanical engineering deeper knowledge and skills of electrical and mechatronics engineering and are therefore able to solve interdisciplinary problems in mechatronics, those sub-disciplines and related disciplines.

| Courses | | | | | | |
|--|--|---|-----------------|------------------------------------|-------------|----------------|
| Title | aarina D | (anima II (I 0004) | | Тур | Hrs/wk | CP |
| Advanced Mechanical Engir Advanced Mechanical Engir | - | • , , | | Lecture Recitation Section (large) | 2 | 2 1 |
| Advanced Mechanical Engir | | | | Lecture | 2 | 2 |
| Advanced Mechanical Engir | neering D | esign I (L0263) | | Recitation Section (large) | 2 | 1 |
| Module Responsible | Prof. D | ieter Krause | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous Knowledge | • | Fundamentals of Mechanica Mechanics Fundamentals of Materials S Production Engineering | | Design | | |
| Educational Objectives | After ta | king part successfully, stude | nts have reache | ed the following learning | results | |
| Professional | | | | | | |
| Competence | ł | assing the module, students | | | | |
| Knowledge | explain complex working principles and functions of machine elements and of basic elements of fluidics, explain requirements, selection criteria, application scenarios and practical examples o complex machine elements, indicate the background of dimensioning calculations. | | | | | |
| Skills | After passing the module, students are able to: accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem solving skills), recognize the content of technical drawings and schematic sketches, evaluate complex designs, technically. | | | | | |
| Personal Competence | | | | | | |
| Social Competence | | Students are able to discimethods. | uss technical i | nformation in the lectu | re supporte | d by activatin |
| Autonomy | Students are able to independently deepen their acquired knowledge in exercises. Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures. | | | | | |
| Workload in Hours | Indepe | ndent Study Time 68, Study | Time in Lecture | 112 | | |
| Credit points | 6 | | | | | |
| Studienleistung | None | | | | | |
| Examination | Written | exam | | | | |
| Examination duration and scale | | | | | | |



General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Assignment for the Following Curricula

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Mechanical Engineering: Core qualification: Compulsory

Naval Architecture: Core qualification: Compulsory



| | d Mechanical Engineering Design II |
|-------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff |
| Language | DE |
| Cycle | SoSe |
| | Advanced Mechanical Engineering Design I & II |
| Content | • Fundamentals of the following machine elements: • Linear rolling bearings • Axes & shafts • Seals • Clutches & brakes • Belt & chain drives • Gear drives • Epicyclic gears • Crank drives • Sliding bearings • Elements of fluidics Exercise • Calculation methods of the following machine elements: • Linear rolling bearings • Axes & shafts • Clutches & brakes • Belt & chain drives • Gear drives • Gear drives • Gear drives • Gear drives • Epicyclic gears • Crank gears • Sliding bearings • Calculations of hydrostatic systems (fluidics) |
| Literature | Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Spring Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktue Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Spring Vieweg, aktuelle Auflage. |



| Course L0265: Advanced Mechanical Engineering Design II | | |
|---|--|--|
| Тур | Typ Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Course L0262: Advance | d Mechanical Engineering Design I | |
|-----------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | rof. Dieter Krause, Prof. Otto von Estorff | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Advanced Mechanical Engineering Design I & II Lecture • Fundamentals of the following machine elements: • Linear rolling bearings • Axes & shafts • Seals • Clutches & brakes • Belt & chain drives • Gear drives • Epicyclic gears • Crank drives • Sliding bearings • Elements of fluidics Exercise • Calculation methods of the following machine elements: • Linear rolling bearings • Axes & shafts • Clutches & brakes • Belt & chain drives • Belt & chain drives • Gear drives • Giding bearings | |
| Literature | Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. | |



| Course L0263: Advanced Mechanical Engineering Design I | |
|--|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M0672: Si | gnals and Systems | | | |
|--------------------------------|---|--|---|--|
| Courses | | | | |
| itle | | Тур | Hrs/wk | СР |
| ignals and Systems (L043 | 2) | Lecture | 3 | 4 |
| ignals and Systems (L043 | 3) | Recitation Section (small) | 2 | 2 |
| Module Responsible | Prof. Gerhard Bauch | | | |
| Admission Requirements | LNANA | | | |
| | Mathematics 1-3 | | | |
| | The modul is an introduction to the theory covered by the moduls Mathematik 1-3 is e (Fourier series, Fourier transform, Laplace tr | xpected. Further experience w | ith spectral | - |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The students are able to classify and describe signals and linear time-invariant (LTI) systems using methods of signal and system theory. They are able to apply the fundamental transformations continuous-time and discrete-time signals and systems. They can describe and analyse determinist | | | |
| Skills | The students are able to describe and analyusing methods of signal and system theory important properties such as magnitude and the impact of LTI systems on the signal prop | r. They can analyse and design by the design that the design t | n basic sys earity etc T | stems regardin |
| Personal Competence | | | | |
| Social Competence | The students can jointly solve specific proble | ems. | | |
| Autonomy | The students are able to acquire relevant information from appropriate literature sources. They ca control their level of knowledge during the lecture period by solving tutorial problems, software tool clicker system. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in | Lecture 70 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 190 min | | | |
| | General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German Engeneering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog Compulsory General Engineering Science (German prog Compulsory General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German prog | ram): Specialisation Computer ram): Specialisation Process E ram): Specialisation Bioproces program): Specialisation program): Specialisation program): Specialisation program, Specialisation Biomedica gram, 7 semester): Specialisation program, 7 semester): Specialisatio | Science: Congineering: s Engineering: s Engineering Civil- and Mechanica al Engineering tion Electric sation Contation Procession | ompulsory Compulsory ng: Compulsor Enviromenta I Engineering ng: Compulsor al Engineering nputer Science |



Focus Biomechanics: Compulsory

Assignment for the

Following Curricula

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Theoretical Mechanical Engineering: Compulsory

Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



| Course L0432: Signals and Systems | | |
|-----------------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| СР | | |
| | Independent Study Time 78, Study Time in Lecture 42 | |
| Lecturer Language | Prof. Gerhard Bauch | |
| Cycle | | |
| Content | Basic classification and description of continuous-time and discrete-time signals and systems Concvolution Power and energy of signals Correlation functions of deterministic signals Linear time-invariant (LTI) systems Signal transformations: Fourier-Series Fourier Transform Laplace Transform Discrete-time Fourier Transform Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT) Z-Transform Analysis and design of LTI systems in time and frequency domain Basic filter types Sampling, sampling theorem Fundamentals of recursive and non-recursive discrete-time filters | |
| Literature | T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004 K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag. B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997 J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002 S. Haykin, B. van Veen: Signals and systems. Wiley. Oppenheim, A.S. Willsky: Signals and Systems. Pearson. Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson. | |



| Course L0433: Signals and Systems | |
|-----------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Gerhard Bauch |
| Language | DE/EN |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | |
|--|--|---|---|---|
| Title | | Тур | Hrs/wk | СР |
| Circuit Theory (L0566) Circuit Theory (L0567) | | Lecture Recitation Section (small) | 3 2 | 4 2 |
| Module Responsible | Prof. Arne Jacob | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Electrical Engineering I and II, Mathematics I and | II II | | |
| Educational Objectives | After taking part successfully, students have read | ched the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Students are able to explain the basic methods for calculating electrical circuits. They know the Fouriseries analysis of linear networks driven by periodic signals. They know the methods for transie analysis of linear networks in time and in frequency domain, and they are able to explain the frequency behaviour and the synthesis of passive two-terminal-circuits. | | | |
| Skills | The students are able to calculate currents and voltages in linear networks by means of basi methods, also when driven by periodic signals. They are able to calculate transients in electrical circuits in time and frequency domain and are able to explain the respective transient behaviour. The are able to analyse and to synthesize the frequency behaviour of passive two-terminal-circuits. | | | |
| Personal Competence | Students work on exercise tasks in small guided their results within the group. | l groups. They are encoura | ged to pres | ent and discu |
| Autonomy | The students are able to find out the required methods for solving the given practice problem Possibilities are given to test their knowledge during the lectures continuously by means of short-tim tests. This allows them to control independently their educational objectives. They can link their gains knowledge to other courses like Electrical Engineering I and Mathematics I. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lec | ture 70 | | |
| Credit points | 6 | | | |
| Studienleistung | | | | |
| Examination Examination duration | Written exam | | | |
| Assignment for the | General Engineering Science (German program General Engineering Science (German program Mechatronics: Compulsory General Engineering Science (German program Focus Mechatronics: Compulsory General Engineering Science (German program Compulsory Electrical Engineering: Core qualification: Comp General Engineering Science (English program) General Engineering Science (English program) Mechatronics: Compulsory | am): Specialisation Mechan, 7 semester): Specialisation, 7 semester): Specialisation, 7 semester): Specialisationsly: Specialisation Electrical E | anical Enginanical Engine Mechanical tion Electrice | neering, Foc cal Engineerin al Engineerin : Compulsory |



Focus Mechatronics: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:
Compulsory
Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory
Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective
Compulsory
Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

| Course L0566: Circuit Theory | | |
|------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| СР | 4 | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | |
| Lecturer | Prof. Arne Jacob | |
| Language | DE | |
| Cycle | WiSe | |
| Content | - Circuit theorems - N-port circuits - Periodic excitation of linear circuits - Transient analysis in time domain - Transient analysis in frequency domain; Laplace Transform - Frequency behaviour of passive one-ports | |
| Literature | - M. Albach, "Grundlagen der Elektrotechnik 1", Pearson Studium (2011) - M. Albach, "Grundlagen der Elektrotechnik 2", Pearson Studium (2011) - L. P. Schmidt, G. Schaller, S. Martius, "Grundlagen der Elektrotechnik 3", Pearson Studium (2011) - T. Harriehausen, D. Schwarzenau, "Moeller Grundlagen der Elektrotechnik", Springer (2013) - A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2008) - R. C. Dorf, J. A. Svoboda, "Introduction to electrical circuits", Wiley (2006) - L. Moura, I. Darwazeh, "Introduction to Linear Circuit Analysis and Modeling", Amsterdam Newnes (2005) | |

| Course L0567: Circuit Theory | |
|------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Arne Jacob |
| Language | DE |
| Cycle | WiSe |
| Content | see interlocking course |
| | siehe korrespondierende Lehrveranstaltung |
| Literature | see interlocking course |



| Courses | | | | |
|--|---|---|---------------|------------------|
| Title Simulation and Design of Mechatronic Systems (L1822) | | Typ Lecture | Hrs/wk | CP 2 |
| Simulation and Design of Me Simulation and Design of Me | | Recitation Section (large) Practical Course | 1 1 | 2 2 |
| Module Responsible | Prof. Uwe Weltin | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Fundatmentals of mechanics, control theory | | | |
| | After taking part successfully, students have | reached the following learning | g results | |
| Professional Competence | | and relatives for decise | | ata laka a a |
| Knowledge | Students are able to describe methods optimization of mechatronic systems. | and calculations for design | , modeling, | simulation an |
| Skills | Students are able to apply modern algorithms imulate and design simple systems and im | | | hey can identify |
| Personal Competence | | | | |
| Social Competence | Ctudents are able to work and evicated in small mixed are una and we contract the total areas are una | | irget groups. | |
| | Students are able to recognize and improve | knowledge deficits independe | ently. | |
| Autonomy | With instructor assistance, students are able to evaluate their own knowledge level and define further course of study. | | el and define | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Studienleistung | | | | |
| | Written exam | | | |
| Examination duration and scale | 90 min | | | |
| Assignment for the Following Curricula | | | | |



Mechanical Engineering: Specialisation Mechatronics: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory Mechatronics: Core qualification: Compulsory

| Course L1822: Simulation and Design of Mechatronic Systems | |
|--|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Uwe Weltin |
| Language | DE |
| Cycle | WiSe |
| Content | Mechatronic Design Modeling Model Identifikation Numerical Methods in simulation Applications and examples in Matlab® and Simulink® |
| Literature | Skript zur Veranstaltung Weitere Literatur in der Veranstaltung |

| Course L1823: Simulation | urse L1823: Simulation and Design of Mechatronic Systems | |
|--------------------------|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Uwe Weltin | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L1824: Simulation and Design of Mechatronic Systems | |
|--|---|
| Тур | Practical Course |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Uwe Weltin |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | | |
|--|--|-------------------------|--|-------------------------|---------------|
| Title Computer Engineering (L032 Computer Engineering (L032 | | | Typ Lecture Recitation Section (small) | Hrs/wk 3 1 | CP 4 2 |
| Module Responsible | Prof. Heiko Falk | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | | | | | |
| Educational Objectives | After taking part success | fully, students have re | ached the following learning | results | |
| Professional Competence | | | | | |
| Knowledge | This module deals with the foundations of the functionality of computing systems. It covers the laye from the assembly-level programming down to gates. The module includes the following topics: • Introduction • Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesic combinational networks • Sequential logic: Flip-flops, automata, systematic hardware design | | | | |
| Personal Competence | | | | | |
| Social Competence | Students are able to solve similar problems alone or in a group and to present the results accordingly | | | | |
| Autonomy | Students are able to acquire new knowledge from specific literature and to associate this knowledg with other classes. | | | | |
| Workload in Hours | Independent Study Time | e 124, Study Time in L | ecture 56 | | |
| Credit points | 6 | | | | |
| | Compulsory Bonus | Form | Description | | |



| Examination duration and scale | 90 minutes, contents of course and labs |
|--------------------------------|---|
| | General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: |
| | Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: |
| | Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Energy and |
| | Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: |
| | Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Aircraft Systems Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Energy Systems: Compulsory |
| | Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory |
| | General Engineering Science (English program): Core qualification: Compulsory |
| Following Curricula | General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental |
| | Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Aircraft Systems Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Energy Systems: Compulsory |
| | |



Computational Science and Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Mechatronics: Core qualification: Compulsory
Technomathematics: Specialisation II. Informatics: Elective Compulsory

| Course L0321: Computer Engineering | | | |
|------------------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 1 | | |
| СР | 4 | | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | | |
| Lecturer | Prof. Heiko Falk | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output | | |
| Literature | A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. | | |

| Course L0324: Computer Engineering | |
|------------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Heiko Falk |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| itie | | Тур | Hrs/wk | СР |
|--|--|---|----------------|------------------|
| ntroduction to Control Syste ntroduction to Control Syste | , , | Lecture Recitation Section (sma | 2 III) 2 | 4 2 |
| Module Responsible | Prof. Herbert Werner | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Representation of signals and s | systems in time and frequency domain, La | aplace transfo | m |
| Educational Objectives | After taking part successfully, st | udents have reached the following learni | ing results | |
| Professional Competence | | | | |
| Knowledge | Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequency response They can explain issues arising when controllers designed in continuous time domain are implemented digitally | | | |
| Skills | Students can transform models of linear dynamic systems from time to frequency domain and vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks | | | |
| Personal Competence | | | | |
| Social Competence | Students can work in small gro their controller designs | oups to jointly solve technical problems | s, and experin | nentally validat |
| Autonomy | Students can obtain informati experiment guides) and use it w | on from provided sources (lecture no then solving given problems. ge in weekly on-line tests and thereby co | | |
| Workload in Hours | Independent Study Time 124, S | tudy Time in Lecture 56 | | |
| Credit points | | <u></u> | | |
| Studienleistung | | | | |
| | Written exam | | | |
| Examination duration and scale | | | | |



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

General Engineering Science (English program): Core qualification: Compulsory

Assignment for the General Englowing Curricula Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory



Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective

Compulsory

Process Engineering: Core qualification: Compulsory

| avT | Lecture | | |
|-------------------|---|--|--|
| Hrs/wk | | | |
| СР | 4 | | |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 | | |
| | Prof. Herbert Werner | | |
| Language | DE | | |
| Cycle | WiSe | | |
| | Signals and systems | | |
| | Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability | | |
| | Feedback systems | | |
| | Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle | | |
| | Root locus techniques Root locus plots Root locus design of PID controllers | | |
| Content | Frequency response techniques Bode diagram Minimum and non-minimum phase systems | | |
| | Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control | | |
| | Time delay systems Root locus and frequency response of time delay systems Smith predictor | | |
| | Digital control | | |
| | Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers | | |
| | Software tools | | |
| | Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course | | |
| Literature | Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic System Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, 2010 | | |



| Course L0655: Introduction to Control Systems | |
|---|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Herbert Werner |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | |
|-----------------------------------|--|---|--|-----------------|
| Title | | Тур | Hrs/wk | СР |
| Semiconductor Circuit Design | gn (L0763) | Lecture | 3 | 4 |
| Semiconductor Circuit Desi | gn (L0864) | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Matthias Kuhl | | | |
| Admission Requirements | None | | | |
| Recommended | Fundamentals of electrical engineering | | | |
| Previous Knowledge | Basics of physics | | | |
| Educational Objectives | After taking part successfully, students hav | re reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Students are able to explain the fur Students know the fundamental of disadvantages. Students have solid knowledge at specifications. Students are able to explain how a Students know the appropriate field | digital logic circuits and can discout memory circuits and can ex | cuss their a plain their force they are a | advantages an |
| Skills | Students can calculate the spector parameters of electronic circuits. Students are able to develop difference circuits. Students can use MOS devices, applications. | erent logic circuits and can des | ign differen | it types of log |
| Personal Competence | | | | |
| Social Competence | Students are able work efficiently ir Students working together in sm questions. | | and answ | er professiona |
| Autonomy | Students are able to assess their le | evel of knowledge. | | |
| Workload in Hours | Independent Study Time 124, Study Time | in Lecture 56 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 120 min | | | |
| | General Engineering Science (German pro General Engineering Science (German Mechatronics: Compulsory General Engineering Science (German p Compulsory General Engineering Science (German pro | program): Specialisation Mecharogram, 7 semester): Specialisa | anical Engi | neering, Focu |



| | Focus Mechatronics: Compulsory |
|--------------------|---|
| | Electrical Engineering: Core qualification: Compulsory |
| | General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory |
| Assignment for th | General Engineering Science (English program): Specialisation Mechanical Engineering, Focus |
| Following Curricul | |
| | General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Mechatronics: Compulsory |
| | Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective |
| | Compulsory |
| | Mechanical Engineering: Specialisation Mechatronics: Compulsory |
| | Mechatronics: Core qualification: Compulsory |
| | Technomathematics: Core qualification: Elective Compulsory |
| | Technomathematics: Specialisation III. Engineering Science: Elective Compulsory |

| | nductor Circuit Design | | |
|-------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 3 | | |
| СР | 4 | | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | | |
| Lecturer | Prof. Matthias Kuhl | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Basic circuits with MOS transistors for logic gates and amplifiers Typical applications for analog and digital circuits Realization of logical functions Memory circuits Scaling-down of CMOS circuits and further perfomance improvements Operational amplifiers and their applications Basic circuits with bipolar transistors Design of exemplary circuits Electrical behavoir of BiCMOS circuits From the summer semester 2017 onwards, students have the possibility to get a bonus of 0,3 to 0,7 for improving the (passed) exam by writing a test on either the 16.05., 13.06. or the 04.07.2017. The test includes 10 questions (time limit: 20 min.). | | |
| Literature | R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011 ISBN: 047170055S HG. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674 K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944 U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage 2012, ISBN 3540428496 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://dx.doi.org/10.1007/978-3-642-20887-4 URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955 URL: http://www.ciando.com/img/bo | | |



| urse L0864: Semicon | ductor Circuit Design | | |
|---------------------|--|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 1 | | |
| СР | | | |
| | ndependent Study Time 46, Study Time in Lecture 14 | | |
| | Prof. Matthias Kuhl | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Basic circuits with MOS transistors for logic gates and amplifiers Typical applications for analog and digital circuits Realization of logical functions Memory circuits Scaling-down of CMOS circuits and further perfomance improvements Operational amplifiers and their applications Basic circuits with bipolar transistors Design of exemplary circuits Electrical behavoir of BiCMOS circuits | | |
| Literature | R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 047170055S HG. Wagemann und T. Schönauer, Silizium-Planartechnologie, Grundprozesse, Physik und Bauelemente, Teubner-Verlag, 2003, ISBN 3519004674 K. Hoffmann, Systemintegration, Oldenbourg-Verlag, 2. Aufl. 2006, ISBN: 3486578944 U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 H. Göbel, Einführung in die Halbleiter-Schaltungstechnik, Berlin, Heidelberg Springer-Verlag Berlin Heidelberg, 2011, ISBN: 9783642208874 ISBN: 9783642208867 URL: http://site.ebrary.com/lib/alltitles/docDetail.action?docID=10499499 URL: http://dx.doi.org/10.1007/978-3-642-20887-4 URL: http://ebooks.ciando.com/book/index.cfm/bok_id/319955 URL: http://www.ciando.com/img/bo | | |



| Module M0854: Ma | thematics IV | | | |
|---|--|--|-------------|------------------|
| Courses | | | | |
| Title Differential Equations 2 (Par | tial Differential Equations) (L1043) | Typ Lecture | Hrs/wk | CP |
| Differential Equations 2 (Par | tial Differential Equations) (L1044) tial Differential Equations) (L1045) | Recitation Section (small) Recitation Section (large) | 1 1 2 | 1 |
| Complex Functions (L1038) Complex Functions (L1041) Complex Functions (L1042) | | Lecture Recitation Section (small) Recitation Section (large) | 1 | 1 |
| Module Responsible | | | | |
| Admission Requirements | | | | |
| Recommended Previous Knowledge | I Mathematice 1 - III | | | |
| Educational Objectives | After taking part successfully, students have | e reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Students can name the basic conce appropriate examples. Students can discuss logical con illustrating these connections with t They know proof strategies and car | nections between these conce he help of examples. | · | _ |
| Skills | Students can model problems in Mathematics IV with the help of the concepts studied in thi course. Moreover, they are capable of solving them by applying established methods. Students are able to discover and verify further logical connections between the concept studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results. | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to work togeth common language. In doing so, they can communicate partners. Moreover, they can desig peers. | new concepts according to the | needs of th | neir cooperating |
| Autonomy | Students are capable of checking to can specify open questions precise Students have developed sufficient oriented manner on hard problems | ly and know where to get help in persistence to be able to work f | solving the | m. |
| Workload in Hours | Independent Study Time 68, Study Time in | Lecture 112 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 60 min (Complex Functions) + 60 min (Diffe | erential Equations 2) | | |
| | | | | |



General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus

General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory

Assignment for the **Following Curricula**

Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus

Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Specialisation Mechatronics: Compulsory

Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective

Compulsory



| Course L1043: Differential Equations 2 (Partial Differential Equations) | | |
|---|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Main features of the theory and numerical treatment of partial differential equations Examples of partial differential equations First order quasilinear differential equations Normal forms of second order differential equations Harmonic functions and maximum principle Maximum principle for the heat equation Wave equation Liouville's formula Special functions Difference methods Finite elements | |
| Literature | http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html | |

| Course L1044: Differential Equations 2 (Partial Differential Equations) | | |
|---|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L1045: Differential Equations 2 (Partial Differential Equations) | | |
|---|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Course L1038: Complex Functions | | |
|---------------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Main features of complex analysis Functions of one complex variable Complex differentiation Conformal mappings Complex integration Cauchy's integral theorem Cauchy's integral formula Taylor and Laurent series expansion Singularities and residuals Integral transformations: Fourier and Laplace transformation | |
| Literature | http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html | |

| Course L1041: Complex Functions | | |
|---------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L1042: Complex Functions | | |
|---------------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0829: Fo | undations of Management | | | |
|--|--|------------------------------------|---------------------------|-----------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | CP |
| Management Tutorial (L088: Introduction to Management | • | Recitation Section (large) Lecture | 2 3 | 3 3 |
| Module Responsible | Prof. Christoph Ihl | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Basic Knowledge of Mathematics and Busine | ess | | |
| Educational Objectives | After taking part successfully, students have i | reached the following learning | results | |
| Professional Competence | | | | 5 . |
| | After taking this module, students know the Management, from Planning and Organisat and Controlling. In particular they are able to explain the differences between Edition Management and to name important of the Management and the students. | ion to Marketing and Innovati | on, and als and the su | o to Investmer |
| Knowledge | explain the most important aspects of and goals in Management and name the most important aspects of entrepringuisal projects. | | | |
| Skills | Students are able to analyse business units with respect to different criteria (organization, objectives strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to • analyse Management goals and structure them appropriately • analyse organisational and staff structures of companies • apply methods for decision making under multiple objectives, under uncertainty and under risk • analyse production and procurement systems and Business information systems • analyse and apply basic methods of marketing • select and apply basic methods from mathematical finance to predefined problems • apply basic methods from accounting, costing and controlling to predefined problems | | | |
| Personal Competence | | | | |
| Social Competence | work successfully in a team of studen to apply their knowledge from the lear report on the project to communicate appropriately and to cooperate respectfully with their fel | cture to an entrepreneurship p | roject and v | vrite a coherer |
| Autonomy | Students are able to work in a team and to organize the team to write a report on their project. | am themselves | | |
| | Independent Study Time 110, Study Time in | Lecture 70 | | |
| Credit points | | | | |
| Studienleistung | , | | | |
| Examination | Subject theoretical and practical work | | | |
| Examination duration | | | | |



and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

Assignment for the Following Curricula

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:

Compulsory
General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:



Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

| Course L0882: Management Tutorial | | |
|-----------------------------------|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Christoph Ihl, Katharina Roedelius, Tobias Vlcek | |
| Language | DE | |
| Cycle | WiSe/SoSe | |
| Content | In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools. If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on self-selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the business knowledge from the lecture should come to practical use. The group projects are guided by a mentor. | |
| Literature | Relevante Literatur aus der korrespondierenden Vorlesung. | |



| urse L0880: Introduct | ion to Management | | |
|-----------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 3 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | |
| Lecturer | Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona | | |
| Language | DE | | |
| Cycle | WiSe/SoSe | | |
| Content | Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects | | |
| Literature | Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttga 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006. | | |



Focus Product Development and Production

The specialization Product Development and Production in the field of study Mechanical Engineering of the course of study General Engineering Science enables a consecutive study of the master Product Development and Production. The specialization maps the product creation process from systematic and methodical development of products, including concept development, design, utilisation of 3D-CAD and Product data management systems, material selection, simulation and test to production, the planning and control and the use of modern manufacturing processes, to high-performance materials.

| Module M0597: Ad | Ivanced Mechanical Engi | neering Design | | |
|--|--|--|---------|---|
| _ | <u> </u> | . | | |
| Courses | | | | |
| Title Typ Hrs/wk CP | | | | |
| Advanced Mechanical Engir | • • • • | Lecture | 2 | 2 |
| Advanced Mechanical Engineering Design II (L0265) Advanced Mechanical Engineering Design I (L0262) Recitation Section (large) 2 1 Lecture 2 2 | | 2 | | |
| Advanced Mechanical Engir | • • , , | Recitation Section (large) | 2 | 1 |
| Module Responsible | Prof. Dieter Krause | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Fundamentals of Mechanical Engineering Design Mechanics Fundamentals of Materials Science Production Engineering | | | |
| Educational Objectives | After taking part successfully, stude | ents have reached the following learning | results | |
| Professional | | | | |
| Competence | | | | |
| Knowledge | explain complex working principles and functions of machine elements and of basic elements of fluidics, explain requirements, selection criteria, application scenarios and practical examples of complex machine elements, indicate the background of dimensioning calculations. | | | |
| Skills | After passing the module, students are able to: accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem solving skills), recognize the content of technical drawings and schematic sketches, evaluate complex designs, technically. | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to discuss technical information in the lecture supported by activating methods. | | | |
| Autonomy | Students are able to independently deepen their acquired knowledge in exercises. Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures. | | | |
| Workload in Hours | Independent Study Time 68, Study | Time in Lecture 112 | | |
| Credit points | 6 | | | |
| Studienleistung | ! <u></u> | | | |
| Examination | Written exam | | | |
| | i | | | |



Examination duration ₁₂₀ and scale General Engineering Science (German program): Specialisation Mechanical Engineering, Focus **Energy Systems: Compulsory** General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory Assignment for the General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Following Curricula Energy Systems: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,

Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory Mechanical Engineering: Core qualification: Compulsory

Naval Architecture: Core qualification: Compulsory



| | Lecture | | |
|-------------------|--|--|--|
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff | | |
| Language | DE | | |
| Cycle | SoSe | | |
| | Advanced Mechanical Engineering Design I & II | | |
| Content | • Fundamentals of the following machine elements: • Linear rolling bearings • Axes & shafts • Seals • Clutches & brakes • Belt & chain drives • Epicyclic gears • Crank drives • Sliding bearings • Elements of fluidics Exercise • Calculation methods of the following machine elements: • Linear rolling bearings • Axes & shafts • Clutches & brakes • Belt & chain drives • Belt & chain drives • Gear drives • Gear drives • Crank gears • Crank gears • Sliding bearings • Calculations of hydrostatic systems (fluidics) | | |
| Literature | Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Spring Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuel Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Spring Vieweg, aktuelle Auflage. | | |



| Course L0265: Advanced Mechanical Engineering Design II | | |
|---|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Course L0262: Advance | d Mechanical Engineering Design I | | |
|-----------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff | | |
| Language | DE | | |
| Cycle | WiSe | | |
| | Advanced Mechanical Engineering Design I & II | | |
| Content | Fundamentals of the following machine elements: | | |
| Literature | Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F. Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. | | |



| Course L0263: Advanced Mechanical Engineering Design I | |
|--|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M0725: Pro | oduction Engineering | | | |
|---|---|---|----------------|-------------------|
| Courses | | | | |
| Title Production Engineering I (LC Production Engineering I (LC Production Engineering II (L Production Engineering II (L | 0612) 0610) | Typ Lecture Recitation Section (large) Lecture Recitation Section (large) | Hrs/wk 2 1 2 1 | CP 2 1 2 |
| Module Responsible | Prof. Wolfgang Hintze | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | no course assessments required internship recommended | | | |
| Educational Objectives | After taking part successfully, students ha | ave reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | name basic criteria for the selection name the main groups of Manufatename the application areas of diftename boundaries, advantages and describe elements, geometric process. explain the essential models of name | acturing Technology. Iferent manufacturing processes. Ind disadvantages of the different no roperties and kinematic variables | | |
| Skills | design manufacturing processe | in accordance with the requirements for simple tasks to meet the neir production-oriented construction | required to | lerances of th |
| Personal Competence | Students are able to | | | |
| Social Competence | develop solutions in a productio | n environment with qualified pers | onnel at tec | hnical level and |
| Autonomy | Students are able to • interpret independently the manu • assess own strengths and weakr • assess their learning progress a • assess possible consequences of | nesses in general. nd define gaps to be improved. | | |
| Workload in Hours | Independent Study Time 96, Study Time | in Lecture 84 | | |
| Credit points | 6 | | | |
| Studienleistung | 1 | | | |
| Examination Examination duration | Written exam 120 min | | | |



| and scale | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
|---------------------|---|
| | Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| Assignment for the | Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| Following Curricula | Focus Theoretical Mechanical Engineering: Elective Compulsory |
| | Focus Product Development and Production: Compulsory Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory |
| | Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory |

| Course L0608: Production | on Engineering I |
|--------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Wolfgang Hintze |
| Language | DE |
| Cycle | WiSe |
| Content | Manufacturing Accuracy Manufacturing Metrology Measurement Errors and Uncertainties Introduction to Forming Massiv forming and Sheet Metal Forming Introduction to Machining Technology Geometrically defined machining (Turning, milling, drilling, broaching, planning) |
| Literature | Dubbel, Heinrich (Grote, Karl-Heinrich.; Feldhusen, Jörg.; Dietz, Peter.; Ziegmann, Gerhard.;) Taschenbuch für den Maschinenbau : mit Tabellen. Berlin [u.a.] : Springer, 2007 Fritz, Alfred Herbert: Fertigungstechnik : mit 62 Tabellen. Berlin [u.a.] : Springer, 2004 Keferstein, Claus P (Dutschke, Wolfgang.;): Fertigungsmesstechnik : praxisorientierte Grundlagen, moderne Messverfahren. Wiesbaden : Teubner, 2008 Mohr, Richard: Statistik für Ingenieure und Naturwissenschaftler : Grundlagen und Anwendung statistischer Verfahren. Renningen : expert-Verl, 2008 Klocke, F., König, W.: Fertigungsverfahren Bd. 1 Drehen, Fäsen, Bohren. 8. Aufl., Springer (2008) Klocke, Fritz (König, Wilfried.;): Umformen. Berlin [u.a.] : Springer, 2006 Paucksch, E.: Zerspantechnik, Vieweg-Verlag, 1996 Tönshoff, H.K.; Denkena, B., Spanen. Grundlagen, Springer-Verlag (2004) |

| Course L0612: Production Engineering I | |
|--|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Wolfgang Hintze |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Course L0610: Production Engineering II | | |
|---|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Wolfgang Hintze, Prof. Claus Emmelmann | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Geometrically undefined machining (grinding, lapping, honing) Introduction into erosion technology Introduction into blastig processes Introduction to the manufacturing process forming (Casting, Powder Metallurgy, Composites) Fundamentals of Laser Technology Process versions and Fundamentals of Laser Joining Technology | |
| Literature | Klocke, F., König, W.: Fertigungsverfahren Bd. 2 Schleifen, Honen, Läppen, 4. Aufl., Springer (2005) Klocke, F., König, W.: Fertigungsverfahren Bd. 3 Abtragen, Generieren und Lasermaterialbearbeitung. 4. Aufl., Springer (2007) Spur, Günter (Stöferle, Theodor.;): Urformen. München [u.a.]: Hanser, 1981 Schatt, Werner (Wieters, Klaus-Peter,; Kieback, Bernd,;): Pulvermetallurgie: Technologien und Werkstoffe. Berlin [u.a.]: Springer, 2007 | |

| Course L0611: Production Engineering II | |
|---|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Wolfgang Hintze, Prof. Claus Emmelmann |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | |
|-----------------------------------|---|--|--------------|----------------|
| Fitle | | Тур | Hrs/wk | СР |
| Advanced Mechanical Desi | gn Project (L0266) | Project-/problem-based Learning | 4 | 6 |
| Module Responsible | Dr. Jens Schmidt | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | 3 - 3 | Design | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | |
| Professional Competence | | to: | | |
| Knowledge | express the procedure for systematic complex design tasks , describe working principles, their use explain guidelines for designing for f explain advanced use-oriented known | e and combination possibilities unction and manufacturing, | ·, | |
| Skills | After passing the module, students are able analyze complex tasks and develop convert principle solutions into a deta use methods to design and solve oriented, create a technical documentation inconfunctions of the system, document calculations of selected methods. | orinciple solutions using sketch alled design, engineering design tasks s cluding all necessary technical | ystematicall | |
| Personal Competence | | | | |
| Social Competence | After passing the module, students are able present and discuss solutions and te reflect the own results in the work groups. | chnical drawings within groups | 5, | |
| Autonomy | After passing the module, students are able independently solve complex denecessary knowledge and selecting to independently solve problems. | sign projects, while motivat | ing themse | lves, acquirin |
| Workload in Hours | Independent Study Time 124, Study Time in | Lecture 56 | | |
| Credit points | | | | |
| Studienleistung | Yes None Attestation | Description | | |
| Examination | Written exam | | | |
| Examination duration and scale | 180 | and the second s | | nanda - F |
| | General Engineering Science (German p Aircraft Systems Engineering: Compulsory General Engineering Science (German p Product Development and Production: Com General Engineering Science (German p Theoretical Mechanical Engineering: Compo General Engineering Science (German prog | rogram): Specialisation Mechoulsory rogram): Specialisation Mech ulsory | anical Engi | neering, Focu |



Assignment for the Following Curricula

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Core qualification: Compulsory

| Course L0266: Advance | d Mechanical Design Project |
|-----------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| СР | 6 |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Lecturer | Dr. Jens Schmidt, Dr. Volkert Wollesen |
| Language | DE |
| Cycle | WiSe |
| | Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung. |
| Content | Getriebekonstruktion in Einzelarbeit Erarbeitung von Lösungsprinzipien Berechnung von Maschinenelementen Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten Erstellung einer ausführlichen Dokumentation Lösungsfindung Methodische Erarbeitung von prinzipiellen Lösungskonzepten Erstellen einer Dokumentation |
| Literature | Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen |



| Module M0726: Pro | oduction Technology | | | |
|--|---|--|--------------|------------------|
| Courses | | | | |
| Title Fundamentals of Machine T Fundamentals of Machine T Forming and Cutting Techno | ools (L1992) | Typ Lecture Recitation Section (large) Lecture | Hrs/wk 2 1 2 | CP 2 1 2 |
| Forming and Cutting Technology | | Recitation Section (large) | 1 | 1 |
| | Prof. Wolfgang Hintze | | | |
| Admission Requirements | | | | |
| - | without major course assessment internship recommended | ics and electrical engineering | | |
| Educational Objectives | After taking part successfully, students have re | eached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | explain the basics of chip formation and mechanisms and models of machining. explain methods and parameters for design and analysis of metal forming, machining processes and tools. | | | |
| Skills | Students are able to • select tool geometry, cutting materials, process parameters and appropriate measuring technique in accordance with the requirements. • estimate occurring forces and temperatures during chip formation. • select appropriate machine tools for machining and create NC programs for turning and milling. • assess the quality of a machine tools and to detect weak points. | | | |
| Personal Competence | ! | | | |
| Social Competence | develop solutions in a production environment represent decisions. | vironment with qualified perso | nnel at tech | nnical level and |
| Autonomy | Students are able to interpret independently cutting proces create independently NC programs. select independently machine tools by assess own strengths and weaknesse assess their learning progress and de assess possible consequences of their | reference to appropriate reques in general. fine gaps to be improved. | uirements. | |
| Workload in Hours | Independent Study Time 96, Study Time in Le | ecture 84 | | |
| Credit points | <u> </u> | | | |
| Studienleistung | <u> </u> | | | |
| | Written exam | | | |
| | | | | |



| Examination duration | |
|--|--|
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory |



| Course L0689: Fundame | entals of Machine Tools |
|-----------------------|--|
| Тур | Lecture |
| Hrs/wk | |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Thorsten Schüppstuhl |
| Language | DE |
| Cycle | |
| | Terminology and trends in machine tool building |
| | CNC controls |
| | NC programming and NC programming systems |
| Content | Types, construction and function of CNC machines |
| | Multi-machinesystems |
| | Equipmentcomponents for machine tools |
| | Assessment of machine tools |
| | Conrad, K.J |
| | Taschenbuch der Werkzeugmaschinen |
| | 9783446406414 |
| | Fachbuchverlag 2006 |
| | |
| | Perović, Božina |
| | Spanende Werkzeugmaschinen - Ausführungsformen und Vergleichstabellen |
| | ISBN: 3540899529 |
| | Berlin [u.a.]: Springer, 2009 |
| | |
| | Weck, Manfred |
| | Werkzeugmaschinen 1 - Maschinenarten und Anwendungsbereiche |
| Literature | ISBN: 9783540225041 |
| | Berlin [u.a.]: Springer, 2005 |
| | |
| | Weck, Manfred; Brecher, Christian |
| | Werkzeugmaschinen 4 - Automatisierung von Maschinen und Anlagen |
| | ISBN: 3540225072 |
| | Berlin [u.a.]: Springer, 2006 |
| | |
| | Weck, Manfred; Brecher, Christian |
| | Werkzeugmaschinen 5 - Messtechnische Untersuchung und Beurteilung, dynamische Stabilität |
| | ISBN: 3540225056 |
| | Berlin [u.a.]: Springer, 2006 |
| | |



| Course L1992: Fundamentals of Machine Tools | | |
|---|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Thorsten Schüppstuhl | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| rse L0613: Forming | and Cutting Technology |
|--------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Wolfgang Hintze |
| Language | DE |
| Cycle | WiSe |
| Content | Thermomechanical Principles and Models of Machining Chip Formation, Forces, Temperature and Tribology process Wear mechanisms and wear patterns Machinability by Cutting and Forming, Specific Problems of Light Weight Structures Cutting Material and Coatings Methods and Parameters for Analysis and Configuration of Forming and Cutting Processes and Tools |
| Literature | Lange, K.; Umformtechnik Grundlagen, 2. Auflage, Springer (2002) Tönshoff, H.; Spanen Grundlagen, 2. Auflage, Springer Verlag (2004) König, W., Klocke, F.; Fertigungsverfahren Bd. 4 <i>Massivumformung</i> , 4. Auflage, VDI-Verlag (1996) König, W., Klocke, F.; Fertigungsverfahren Bd. 5 <i>Blechbearbeitung</i> , 3. Auflage, VDI-Verlag (1995) Klocke, F., König, W.; Fertigungsverfahren <i>Schleifen, Honen, Läppen</i> , 4. Auflage, Springer Verlag (2005) König, W., Klocke, F.: Fertigungsverfahren <i>Drehen, Fräsen, Bohren</i> , 7. Auflage, Springer Verlag (2002) |

| Course L0614: Forming and Cutting Technology | | | |
|--|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Wolfgang Hintze | | |
| Language | | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |



| Courses | | | | | |
|--|---|-----------------------|---------------------------------------|---------------------|--|
| Title Computer Engineering (L032 Computer Engineering (L032 | | | Typ Lecture Recitation Section (small | Hrs/wk 3 I) 1 | CP 4 2 |
| Module Responsible | Prof. Heiko Falk | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | | | | | |
| Educational Objectives | After taking part success | sfully, students have | reached the following learning | ng results | |
| Professional | | | | | |
| Competence | This module deals with | the foundations of t | ne functionality of computing | , avatama lt a | avara tha lavar |
| Knowledge | from the assembly-level programming down to gates. The module includes the following topics: Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthes combinational networks Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture pipelining Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-po connections, busses | | | ware synthesis | |
| Skills | The students perceive computer systems from the architect's perspective, i.e., they identify the interrestructure and the physical composition of computer systems. The students can analyze, how high specific and individual computers can be built based on a collection of few and simple component They are able to distinguish between and to explain the different abstraction layers of toda computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependence between a physical computer system and the software executed on it. In particular, they should understand the consequences that the execution of software has on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to propose feasible options. | | | | lyze, how highly ble components ayers of today' erdependencie cular, they sha entric abstraction to evaluate the |
| Personal Competence | | | | | |
| Social Competence | Students are able to solv | ve similar problems | alone or in a group and to pr | esent the resu | ılts accordingly. |
| Autonomy | Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. | | | | |
| Workload in Hours | Independent Study Time | e 124, Study Time in | Lecture 56 | | |
| Credit points | - | | | | |
| | Compulsory Bonus | Form | Description | | |



| Examination duration and scale | 90 minutes, contents of course and labs |
|--------------------------------|---|
| | General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and |
| | Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory |
| | Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory |
| | General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental |
| | Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory |



Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory

| Course L0321: Compute | r Engineering | | |
|-----------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | | | |
| СР | 4 | | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | | |
| Lecturer | Prof. Heiko Falk | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output | | |
| Literature | A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. | | |

| Course L0324: Computer Engineering | | |
|------------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | |
|---|--|--|---------------|---------------|
| Title | | Тур | Hrs/wk | СР |
| Introduction to Control Systems (L0654) Introduction to Control Systems (L0655) | | Lecture Recitation Section (small) | 2 2 | 4 2 |
| Module Responsible | Prof. Herbert Werner | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Representation of signals and sys | stems in time and frequency domain, Lap | lace transfor | rm |
| Educational Objectives | After taking part successfully, stud | dents have reached the following learning | g results | |
| Professional Competence | | | | |
| Knowledge | Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequency response They can explain issues arising when controllers designed in continuous time domain are implemented digitally | | | |
| Skills | Students can transform models of linear dynamic systems from time to frequency domain and vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks | | | |
| Personal Competence | | | | |
| Social Competence | Students can work in small groups to jointly solve technical problems, and experimentally validate | | | |
| Autonomy | their controller designs Students can obtain information from provided sources (lecture notes, software documentatio experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress. | | | |
| Workload in Hours | Independent Study Time 124, Stu | Idv Time in Lecture 56 | | |
| Credit points | · | | | |
| Studienleistung | | | | |
| | Written exam | | | |
| Examination duration and scale | | | | |
| | | erman program): Core qualification: Com German program, 7 semester): Specia | - | nputer Sciend |



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

General Engineering Science (English program): Core qualification: Compulsory

Assignment for the General Englowing Curricula Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory



Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective

Compulsory

Process Engineering: Core qualification: Compulsory

| Course L0654: Introduct | ion to Control Systems |
|-------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. Herbert Werner |
| Language | DE |
| Cycle | WiSe |
| Content | Signals and systems Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle Root locus techniques Root locus design of PID controllers Frequency response techniques Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Time delay systems Root locus and frequency response of time delay systems Smith predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools Introduction to Matlab, Simulink, Control toolbox |
| Literature | Computer-based exercises throughout the course Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems' Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N. 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010 |



| Course L0655: Introduction to Control Systems | | |
|---|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Herbert Werner | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0599: Int | egrated Product Dev | velopment and L | ightweight Desigr | 1 | |
|---|---|---|---|--------------|----------------|
| Courses | | | | | |
| Title | | | Тур | Hrs/wk | СР |
| CAE-Team Project (L0271) | | | Project-/problem-based Learning | 2 | 2 |
| Development of Lightweight Integrated Product Develope | • , , | | Lecture Lecture | 2 2 | 2 2 |
| Module Responsible | Prof. Dieter Krause | | | | |
| Admission Requirements | | | | | |
| Recommended Previous Knowledge | Advanced Knowledge about engineering design: Fundamentals of Mechanical Engineering Design Mechanical Engineering: Design Advanced Mechanical Engineering Design | | | | |
| Educational Objectives | After taking part successfull | y, students have reache | ed the following learning | results | |
| Professional Competence | | e, students are capable | of: | | |
| Knowledge | explaining the functional principle of 3D-CAD-Systems, PDM- and FEM-Systems describing the interaction of the different CAE-Systems in the product development process | | | | |
| Skills | classification schem | AD- and PDM-Systems es and product structur | s with regards to the dering PDM- and/or FEM-Systen | | |
| Personal Competence | | | | | |
| Social Competence | After completing the module To develop a project group discussions Present project resu | ct plan and allocate wo | ork appropriate work pac ce in a presentation | ckages in th | ne framework o |
| Autonomy | Students are capable of: • independently adap | t to a CAE-Tool and co | mplete a given practical | task with it | |
| Workload in Hours | Independent Study Time 96 | s, Study Time in Lecture | 84 | | |
| Credit points | 6 | | | | |
| Studienleistung | Yes 20 % | Form Subject theoretical oractical work | Description and CAE-Teamproje Ausarbeitung | ekt inkl. | Vortrag und |
| | Written exam | | | | |
| Examination duration and scale | 90 | | | | |
| | General Engineering Scie Aircraft Systems Engineerin General Engineering Scie Product Development and F | ig:Compulsory nce (German progran | n): Specialisation Mech | | _ |



| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory |
|---------------------|---|
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory |
| Assignment for the | General Engineering Science (English program): Specialisation Mechanical Engineering, Focus |
| Following Curricula | Aircraft Systems Engineering: Compulsory |
| Following Curricula | General Engineering Science (English program): Specialisation Mechanical Engineering, Focus |
| | Product Development and Production: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Aircraft Systems Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory |
| | Mechanical Engineering: Specialisation Product Development and Production: Compulsory |
| | Mechanical Engineering: Specialisation Aircraft Systems Engineering: Compulsory |
| | Product Development, Materials and Production: Technical Complementary Course Core Studies: |
| | Elective Compulsory |

| Course L0271: CAE-Team Project | | | |
|--------------------------------|--|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Dieter Krause | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Practical Introduction in the used software systems (Creo, Windchill, Hyperworks) Team formation, allocation of tasks and generation of a project plan Collective creation of one product out of CAD models supported by FEM calculations and PDM system Manufacturing of selected parts using 3D printer Presentation of results Description Part of the module is a project based team orientated practical course using the PBL method. In this course, students learn the handling of modern CAD, PDM and FEM systems (Creo, Windchill and Hyperworks). After a short introduction in the applied software systems, students work in teams on a task during the semester. The aim is the development of one product out of several CAD parts models using a PDM system including FEM calculations of selected parts and 3D printing of parts. The developed product must be presented in a joint presentation. | | |
| Literature | - | | |



| Course L0270: Development of Lightweight Design Products | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Dieter Krause, Prof. Benedikt Kriegesmann | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Lightweight design materials Product development process for lightweight structures Dimensioning of lightweight structures | |
| Literature | Schürmann, H., "Konstruieren mit Faser-Kunststoff-Verbunden", Springer, Berlin, 2005. Klein, B., "Leichtbau-Konstruktion", Vieweg & Sohn, Braunschweig, 1989. Krause, D., "Leichtbau", In: Handbuch Konstruktion, Hrsg.: Rieg, F., Steinhilper, R., München, Carl Hanser Verlag, 2012. Schulte, K., Fiedler, B., "Structure and Properties of Composite Materials", Hamburg, TUHH - TuTech Innovation GmbH, 2005. Wiedemann, J., "Leichtbau Band 1: Elemente", Springer, Berlin, Heidelberg, 1986. | |

| Course L0269: Integrated Product Development I | | |
|--|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Dieter Krause | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Introduction to Integrated Product Development 3D CAD -Systems and CAD interfaces Administration of part lists / PDM systems PDM in different industries Selection of CAD-/PDM Systems Simulation Construction methods Design for X | |
| Literature | Ehrlenspiel, K.: Integrierte Produktentwicklung, München, Carl Hanser Verlag Lee, K.: Principles of CAD / CAM / CAE Systems, Addison Wesles Schichtel, M.: Produktdatenmodellierung in der Praxis, München, Carl Hanser Verlag Anderl, R.: CAD Schnittstellen, München, Carl Hanser Verlag Spur, G., Krause, F.: Das virtuelle Produkt, München, Carl Hanser Verlag | |



| Module M1005: En | hanced Fundamentals of Materials | Science | | |
|---|--|--|-----------------------|-----------------|
| Courses | | | | |
| Title Enhanced Fundamentals: Ceramics and Polymers (L1233) Enhanced Fundamentals: Ceramics and Polymers (L1234) Enhanced Fundamentals: Metals (L1086) | | Typ Lecture Recitation Section (large) Lecture | Hrs/wk 2 1 2 | CP 2 1 3 |
| Module Responsible | Prof. Gerold Schneider | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Module "Fundamentals of Materials Science" Module "Materials Science Laboratory" Module "Advanced Materials" | | | |
| Educational Objectives | After taking part successfully, students have read | ched the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The students are able to give an enhanced overview over the following topics in metals, polymers and ceramics: Atomic bonds, crystal and amorphous structures, defects, electrica and mass transport, microstructure and phase diagrams. They are capable to explain the corresponding technical terms. | | | |
| Skills | The students are able to apply the appropriate physical and chemical methods for the above mentioned subjects. | | | |
| Personal Competence | | | | |
| Social Competence Autonomy | The students are capable to understand independently the structure and propeties of ceramics, metals and polymers. They should be able to critally evaluate the profoundness of their knowledge. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lec | ture 70 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 180 min | | | |
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory Mechanical Engineering: Specialisation Materials in Engineering Sciences: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory | | | |



| | Lecture |
|----------|--|
| Hrs/wk | 2 |
| СР | 2 |
| | Independent Study Time 32, Study Time in Lecture 28 |
| | Prof. Gerold Schneider, Prof. Bodo Fiedler |
| Language | |
| Cycle | |
| | Einführung Natürliche "Keramiken" - Steine "Künstliche" Keramik - vom Porzellan bis zur Hochleistungskeramik Anwendungen von |
| | Hochleistungskeramik 2. Pulverherstellung |
| | Einteilung der Pulversyntheseverfahren Der Bayer-Prozess zur Al2O3-Herstellung Der Acheson-Prozess zur SiC-Herstellung Chemical Vapour Deposition |
| | Pulveraufbereitung |
| | Mahltechnik Sprühtrockner |
| | 3. Formgebung |
| | Arten der Formgebung Pressen (0 - 15 % Feuchte) Gießen (> 25 % Feuchte) Plastische Formgebung (15 - 25 % Feuchte) |
| Content | 4. Sintern |
| | Triebkraft des Sinterns Effekt von gekrümmten Oberflächen und Diffusionswegen Sinterstadien des isothermen Festphasensinterns Herring scaling laws Heißisostatisches Pressen |
| | 5. Mechanische Eigenschaften von Keramiken |
| | Elastisches und plastisches Materialverhalten Bruchzähigkeit - Linear-elastische Bruchmechanik Festigkeit - Festigkeitsstreuung |
| | 6. Elektrische Eigenschaften von Keramiken |
| | Ferroelektische Keramiken |
| | Piezo-, ferroelektrische Materialeigenschaften Anwendungen |
| | Keramische lonenleiter |
| | lonische Leitfähigkeit Dotiertes Zirkonoxid in der Brennstoffzelle und Lambdasonde |
| | D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Application and Design, Elesevier |
| | D.W. Richerson, Modern Ceramic Engineering, Marcel Decker, New York, 1992 |
| | W.D. Kingery, Introduction to Ceramics, John Wiley & Sons, New York, 1975 |
| | D.J. Green, An introduction to the mechanical properties of ceramics", Cambridge University Press 1998 |



Literature

Polymerwerkstoffe
Struktur und mechanische Eigenschaften G.W.Ehrenstein;
Hanser Verlag; ISBN 3-446-12478-0; ca. 20 €

Kunststoffphysik
W.Retting, H.M.Laun; Hanser Verlag; ISBN 3446162356; ca. 25 €

Werkstoffkunde Kunststoffe
G.Menges; Hanser Verlag; ISBN 3-446-15612-7; ca. 25 €

Kunststoff-Kompendium
A.Frank, K. Biederbick; Vogel Buchverlag; ISBN 3-8023-0135-8; ca.30 €

| Course L1234: Enhanced Fundamentals: Ceramics and Polymers | | |
|--|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Gerold Schneider, Prof. Bodo Fiedler | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Course L1086: Enhanced Fundamentals: Metals | | |
|---|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Jörg Weißmüller, Prof. Patrick Huber | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Enhanced Fundamentals of Metals: Introduction to phenomenological thermodynamics Elasticity Thermal materials behavior (heat capacity, thermal expansion) Conductors, semiconductors, isolators: conduction mechanisms and band structure Superconductors Dry corrosion Electrochemistry in the material sciences Wet corrosion Alloy corrosion Corrosion protection Stainless steel Battery materials Supercapacitors Fuel cells Materials for hydrogen storage Magnetism: phenomenology, Magnetometers, atomistics, micromagnetism Magnetic materials: applications | |
| Literature | Vorlesungsskript | |



| Module M0829: Fo | undations of Management | | | |
|--|--|------------------------------------|---------|--------|
| Courses | | | | |
| Title | 0 | Typ | Hrs/wk | CP |
| Management Tutorial (L0882 Introduction to Management | | Recitation Section (large) Lecture | 2 3 | 3 3 |
| Module Responsible | Prof. Christoph Ihl | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | | s | | |
| Educational Objectives | After taking part successfully, students have re | ached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Management, from Planning and Organisation to Marketing and Innovation, and also to Investmen and Controlling. In particular they are able to explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects describe and explain basic business functions as production, procurement and sourcing supply chain management, organization and human ressource management, information management, innovation management and marketing explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance state basics from accounting and costing and selected controlling methods. | | | |
| Skills | Students are able to analyse business units with respect to different criteria (organization, objectives strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to • analyse Management goals and structure them appropriately • analyse organisational and staff structures of companies • apply methods for decision making under multiple objectives, under uncertainty and under risk • analyse production and procurement systems and Business information systems • analyse and apply basic methods of marketing • select and apply basic methods from mathematical finance to predefined problems • apply basic methods from accounting, costing and controlling to predefined problems | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a coherer | | | |
| Autonomy | Students are able to work in a team and to organize the team themselves to write a report on their project. | | | |
| | Independent Study Time 110, Study Time in Le | ecture 70 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| | Subject theoretical and practical work | | | |
| Examination duration | | | | |



and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

Assignment for the Following Curricula

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:

Compulsory
General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:



Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

| Course L0882: Management Tutorial | | |
|-----------------------------------|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Christoph Ihl, Katharina Roedelius, Tobias VIcek | |
| Language | DE | |
| Cycle | WiSe/SoSe | |
| Content | In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools. If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on self-selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the business knowledge from the lecture should come to practical use. The group projects are guided by a mentor. | |
| Literature | Relevante Literatur aus der korrespondierenden Vorlesung. | |



| irse L0880: Introduct | ion to Management |
|-----------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrir Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona |
| Language | DE |
| Cycle | WiSe/SoSe |
| Content | Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects |
| Literature | Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgar 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006. |



Focus Theoretical Mechanical Engineering

The graduates acquire basic research and methodological oriented content mechanical engineering knowledge and associated mechanical engineering expertise to develop mathematical descriptions, analysis and synthesis of basic technical systems methods, products or processes. This course, concentrates on simulation technology, advanced mathematics and heat transfer, such that a continuous study in the Master program in Theoretical Mechanical Engineering is possible.

| Module M0597: Ad | Ivanced Mechanical Engine | ering Design | | |
|--|--|-------------------------------------|---------|--------|
| | Tanou moonamoar Engine | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Advanced Mechanical Engin | neering Design II (L0264) | Lecture | 2 | 2 |
| Advanced Mechanical Engin | | Recitation Section (large) | 2 | 1 |
| Advanced Mechanical Engin Advanced Mechanical Engin | | Lecture | 2 | 2 1 |
| | · · · · · · · · · · · · · · · · · | Recitation Section (large) | 2 | ı |
| Module Responsible Admission | | | | |
| Requirements | l None | | | |
| Recommended Previous Knowledge | Fundamentals of Mechanical Engineering Design Mechanics | | | |
| Educational Objectives | After taking part successfully, students | have reached the following learning | results | |
| Professional | | | | |
| Competence | | | | |
| Knowledge | explain complex working principles and functions of machine elements and of basic element of fluidics, explain requirements, selection criteria, application scenarios and practical examples complex machine elements, indicate the background of dimensioning calculations. | | | |
| Skills | After passing the module, students are able to: accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem solving skills), recognize the content of technical drawings and schematic sketches, evaluate complex designs, technically. | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to discuss technical information in the lecture supported by activating methods. | | | |
| Autonomy | Students are able to independently deepen their acquired knowledge in exercises. Students are able to acquire additional knowledge and to recapitulate poorly understood content e.g. by using the video recordings of the lectures. | | | |
| Workload in Hours | Independent Study Time 68, Study Tin | ne in Lecture 112 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration | <u> </u> | | | |



and scale 120

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus **Energy Systems: Compulsory**

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Assignment for the

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Following Curricula Energy Systems: Compulsory

> General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

> General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

> General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

> General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

> General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

> General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

> General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

> General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

> General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

> General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

> General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

> General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory



| | d Mechanical Engineering Design II |
|-------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff |
| Language | DE |
| Cycle | SoSe |
| | Advanced Mechanical Engineering Design I & II |
| Content | Fundamentals of the following machine elements: |
| Literature | Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Spring Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktue Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Spring Vieweg, aktuelle Auflage. |



| Course L0265: Advanced Mechanical Engineering Design II | |
|---|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Course L0262: Advance | d Mechanical Engineering Design I |
|-----------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff |
| Language | DE |
| Cycle | WiSe |
| | Advanced Mechanical Engineering Design I & II |
| Content | Fundamentals of the following machine elements: |
| Literature | Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F. Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springe Vieweg, aktuelle Auflage. |



| Course L0263: Advanced Mechanical Engineering Design I | |
|--|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause, Prof. Otto von Estorff |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | |
|----------------------------|---|--|--|---|
| Title | | Тур | Hrs/wk | СР |
| Signals and Systems (L043) | 2) | Lecture | 3 | 4 |
| Signals and Systems (L043 | 3) | Recitation Section (small) | 2 | 2 |
| Module Responsible | Prof. Gerhard Bauch | | | |
| Admission | None | | | |
| Requirements | | | | |
| | Mathematics 1-3 | | | |
| | The modul is an introduction to the theory covered by the moduls Mathematik 1-3 is e (Fourier series, Fourier transform, Laplace transform) | xpected. Further experience w | ith spectral | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | |
| Professional | | | | |
| Competence | | dia atamata 2000 - 2000 | | |
| Knowledge | The students are able to classify and describe signals and linear time-invariant (LTI) systems usin methods of signal and system theory. They are able to apply the fundamental transformations continuous-time and discrete-time signals and systems. They can describe and analyse determinist signals and systems mathematically in both time and image domain. In particular, they understand the effects in time domain and image domain which are caused by the transition of a continuous-time signal to a discrete-time signal. | | | |
| Skills | The students are able to describe and analyse deterministic signals and linear time-invariant system using methods of signal and system theory. They can analyse and design basic systems regardir important properties such as magnitude and phase response, stability, linearity etc They can asses the impact of LTI systems on the signal properties in time and frequency domain. | | | |
| Personal Competence | | | | |
| Social Competence | The students can jointly solve specific proble | ems. | | |
| Autonomy | The students are able to acquire relevant information from appropriate literature sources. They can control their level of knowledge during the lecture period by solving tutorial problems, software tool clicker system. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in | Lecture 70 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration | 90 min | | | |
| and scale | General Engineering Science (German prog | ram): Charialization Floatrical | Enginooring | · Compulação |
| | General Engineering Science (German prog General Engineering Science (German prog General Engineering Science (German Engeneering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German prog General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory | ram): Specialisation Bioproces program): Specialisation program): Specialisation ram): Specialisation Biomedica gram, 7 semester): Specialisation program, 7 se | s Engineeri Civil- and Mechanica al Engineeri tion Electric isation Con ation Proces | ng: Compulson Enviroment Engineering ng: Compulson al Engineering nputer Science as Engineering |
| | Compulsory General Engineering Science (German prog Compulsory | | · | |
| | Compulsory General Engineering Science (German prog | ram, 7 semester): Specialisatio | on Mechanic | al Engine |



Focus Biomechanics: Compulsory

Assignment for the

Following Curricula

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



| Course L0432: Signals and Systems | | |
|-----------------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| СР | | |
| | Independent Study Time 78, Study Time in Lecture 42 | |
| Lecturer Language | Prof. Gerhard Bauch | |
| Cycle | | |
| Content | Basic classification and description of continuous-time and discrete-time signals and systems Concvolution Power and energy of signals Correlation functions of deterministic signals Linear time-invariant (LTI) systems Signal transformations: Fourier-Series Fourier Transform Laplace Transform Discrete-time Fourier Transform Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT) Z-Transform Analysis and design of LTI systems in time and frequency domain Basic filter types Sampling, sampling theorem Fundamentals of recursive and non-recursive discrete-time filters | |
| Literature | T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004 K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag. B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997 J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002 S. Haykin, B. van Veen: Signals and systems. Wiley. Oppenheim, A.S. Willsky: Signals and Systems. Pearson. Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson. | |



| Course L0433: Signals and Systems | |
|-----------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Gerhard Bauch |
| Language | DE/EN |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | |
|---|--|---|--------------|----------------|
| Title Advanced Mechanical Desiç | gn Project (L0266) | Typ Project-/problem-based Learning | Hrs/wk 4 | CP 6 |
| Module Responsible | Dr. Jens Schmidt | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | 3 3 | Design | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | |
| Professional Competence | | to: | | |
| Knowledge | express the procedure for systematic complex design tasks , describe working principles, their use explain guidelines for designing for f explain advanced use-oriented known | ally handling of and combination possibilities unction and manufacturing, | ·, | |
| Skills | After passing the module, students are able analyze complex tasks and develop convert principle solutions into a deta use methods to design and solve oriented, create a technical documentation included functions of the system, document calculations of selected methods. | orinciple solutions using sketch tiled design, engineering design tasks s luding all necessary technical | ystematicall | |
| Personal Competence | | | | |
| Social Competence | After passing the module, students are able • present and discuss solutions and te • reflect the own results in the work gro | chnical drawings within groups | 5, | |
| Autonomy | After passing the module, students are able independently solve complex denecessary knowledge and selecting to independently solve problems. | sign projects, while motivat | ing themse | lves, acquirin |
| Workload in Hours | Independent Study Time 124, Study Time in | Lecture 56 | | |
| Credit points | 6 | | | |
| Studienleistung | Yes None Attestation | Description | | |
| Examination | Written exam | | | |
| Examination duration and scale | 180 General Engineering Science (German n | rogram): Chanieliastics Mark | unnical En- | nooring Fo |
| | General Engineering Science (German p Aircraft Systems Engineering: Compulsory General Engineering Science (German p Product Development and Production: Comp General Engineering Science (German p Theoretical Mechanical Engineering: Compu General Engineering Science (German prog | rogram): Specialisation Mechoulsory rogram): Specialisation Mech ulsory | anical Engi | neering, Focu |



Assignment for the Following Curricula

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Core qualification: Compulsory

| Course L0266: Advanced Mechanical Design Project | | |
|--|---|--|
| Typ Project-/problem-based Learning | | |
| Hrs/wk | 4 | |
| СР | 6 | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | |
| Lecturer | Dr. Jens Schmidt, Dr. Volkert Wollesen | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Das Konstruktionsprojekt gliedert sich in den Entwurf eines Getriebes sowie die Lösungsfindung. • Getriebekonstruktion in Einzelarbeit • Erarbeitung von Lösungsprinzipien • Berechnung von Maschinenelementen • Entwurf eines Getriebes im Hauptschnitt plus allen Außenansichten • Erstellung einer ausführlichen Dokumentation • Lösungsfindung • Methodische Erarbeitung von prinzipiellen Lösungskonzepten • Erstellen einer Dokumentation | |
| Literature | Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen | |



| Courses | | | | | |
|--|--|--|---|--|--|
| Title | | Тур | Hrs/wk | СР | |
| Heat Transfer (L0458) Heat Transfer (L0459) | | Lecture Recitation Section (large) | 3 2 | 4 2 | |
| Module Responsible | Dr. Andreas Moschallski | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | Technical Thermodynamics I, II and Fluid Dynamics | | | | |
| Educational Objectives | After taking part successfully, students | have reached the following learning | results | | |
| Professional Competence | | | | | |
| | The students are able to | | | | |
| | - describe the different physical mecha | nism of Heat Transfer, | | | |
| Knowledge | - explain the technical terms, | | | | |
| | - to analyse comlex heat transfer proce | esses in a critical way. | | | |
| | The students are able to | | | | |
| | - understand the physics of Heat Trans | sfer, | | | |
| Skills | | | | | |
| | - solve excersises self-consistent and i | n small groups. | | | |
| Personal Competence | | | | | |
| Social Competence | The students are able to discuss in sm | all groups and develop an approach | | | |
| · | The students are able to develop a critical way. A qualified exchange with | | nd analyse | the results | |
| Workload in Hours | Independent Study Time 110, Study Ti | me in Lecture 70 | | | |
| Credit points | · | THE III EGOLUIO 70 | | | |
| Studienleistung | | | | | |
| = | Written exam | | | | |
| Examination | | | | | |
| Examination Examination duration and scale | 120 min | | | | |
| Examination duration | General Engineering Science (Germ Biomechanics: Compulsory General Engineering Science (Germ Energy Systems: Compulsory General Engineering Science (German General Engineering Science (German General Engineering Science (German Theoretical Mechanical Engineering: General Engineering Science (German Focus Energy Systems: Compulsory General Engineering Science (German Focus Theoretical Mechanical Engineering Science (German Focus En | nan program): Specialisation Mech n program): Specialisation Biomedica nan program): Specialisation Mech Compulsory n program, 7 semester): Specialisation n program, 7 semester): Specialisation | anical Engi al Engineeri anical Engi on Mechanic | neering, Fong: Compulineering, Fongal Enginee | |
| Examination duration and scale | General Engineering Science (Germ Biomechanics: Compulsory General Engineering Science (Germ Energy Systems: Compulsory General Engineering Science (German General Engineering Science (German Theoretical Mechanical Engineering: General Engineering Science (German Focus Energy Systems: Compulsory General Engineering Science (German Focus Theoretical Mechanical Engineering Science (German Focus Theoretical Mechanical Engineering General Engineering Science (German General Engineering Science (German Compulsory | nan program): Specialisation Mech n program): Specialisation Biomedica nan program): Specialisation Mech Compulsory n program, 7 semester): Specialisation program, 7 semester): Specialisation ering: Compulsory n program, 7 semester): Specialisation | anical Engi al Engineeri anical Engi on Mechanic on Mechanic | ng: Compulineering, Focal Engineering cal Engi | |
| Examination duration and scale Assignment for the | General Engineering Science (Germ Biomechanics: Compulsory General Engineering Science (Germ Energy Systems: Compulsory General Engineering Science (German General Engineering Science (German Theoretical Mechanical Engineering: General Engineering Science (German Focus Energy Systems: Compulsory General Engineering Science (German Focus Theoretical Mechanical Engineering Science (German Focus Theoretical Mechanical Engineering Science (German General Engineering General Engineering Science (German General Engineering General Eng | nan program): Specialisation Mechan program): Specialisation Biomedication program): Specialisation Mechan program, 7 Semester): Specialisation program): Specialisation Biomedication program): Specialisation Mechanics | anical Engi al Engineeri anical Engi on Mechanic on Mechanic on Biomedic al Engineerir anical Engi | ineering, Formal Engineering Engineering Engineering: Compuls neering, Formal Engineering, Formal Engineer | |



Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Energy Systems: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
Compulsory
Mechanical Engineering: Specialisation Energy Systems: Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

| Course L0458: Heat Tra | nsfer |
|------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Dr. Andreas Moschallski |
| Language | DE |
| Cycle | WiSe |
| Content | Dimensional analysis, heat conduction, convective heat transfer, Two-phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods |
| Literature | - Herwig, H.; Moschallski, A.: Wärmeübertragung, 3. Auflage, Springer Vieweg Verlag, Wiesbaden, 2014 - Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000 - Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996 |

| Course L0459: Heat Transfer | | |
|-----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Dr. Andreas Moschallski | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | | |
|--|---|---------------------------|---|---------------|-----------------|
| Title Computer Engineering (L032 | 21) | | Typ Lecture | Hrs/wk 3 | CP 4 |
| Computer Engineering (L032 | | | Recitation Section (small) | - | 2 |
| Module Responsible | Prof. Heiko Falk | | | | |
| Admission Requirements | None | | | | |
| • | Basic knowledge in elec | trical engineering | | | |
| Recommended | The successful comple examination according to | | e honored during the | evaluation o | of the module's |
| Previous Knowledge | | | | | |
| Educational Objectives | After taking part success | fully, students have reac | hed the following learnin | g results | |
| Professional Competence | | | | | |
| | | | unctionality of computing | | |
| Knowledge | from the assembly-level programming down to gates. The module includes the following topics: Introduction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis combinational networks Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations Computer arithmetic: Integer addition, subtraction, multiplication and division Basics of computer architecture: Programming models, MIPS single-cycle architecture pipelining Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-poin connections, busses | | | | |
| Skills | The students perceive computer systems from the architect's perspective, i.e., they identify the intern structure and the physical composition of computer systems. The students can analyze, how high specific and individual computers can be built based on a collection of few and simple component. They are able to distinguish between and to explain the different abstraction layers of today computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependence between a physical computer system and the software executed on it. In particular, they shaunderstand the consequences that the execution of software has on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to propose | | | | |
| | feasible options. | | - · · · · · · · · · · · · · · · · · · · | | |
| Personal Competence | Ctudonto ovo oblo to colu | o olmilou sustitutus s | a auto a aussius e i diti | الله م | lto ooseeelteel |
| Social Competence | Students are able to solv | e siiililai problems alon | e or in a group and to pre | seni ine resu | ns accordingly. |
| Autonomy | Students are able to according with other classes. | quire new knowledge fro | om specific literature and | to associate | this knowledge |
| Workload in Hours | Independent Study Time | 124, Study Time in Lect | ture 56 | | |
| Credit points | ļ | <u>-</u> | | | |
| Studienleistung | Compulsory Bonus | Form | Description | | |



| Examination duration and scale | 90 minutes, contents of course and labs |
|--------------------------------|--|
| | General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and |
| | Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory |
| Accianment for the | Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory |
| = | General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering, Compulsory |
| | Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Energy Systems: Compulsory |



Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory

| Course L0321: Compute | r Engineering |
|-----------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Heiko Falk |
| Language | DE |
| Cycle | WiSe |
| Content | Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output |
| Literature | A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. |

| Course L0324: Computer Engineering | | |
|------------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | | |
|--|--|-------------------------|---------------------------------------|----------------|------------------|
| Γitle | | | Тур | Hrs/wk | СР |
| Introduction to Control Systems (L0654) Introduction to Control Systems (L0655) | | | Lecture Recitation Section (small) | 2 2 | 4 |
| Module Responsible | Prof. Herbert Werr | er | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | Representation of | signals and systems in | time and frequency domain, Lap | place transfor | m |
| Educational Objectives | After taking part su | ccessfully, students ha | ve reached the following learnin | g results | |
| Professional Competence | | | | | |
| Knowledge | Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequency response They can explain issues arising when controllers designed in continuous time domain are implemented digitally | | | | |
| Skills | Students can transform models of linear dynamic systems from time to frequency domain ar vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus ar frequency response techniques They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks | | | | |
| Personal Competence | | | | | |
| Social Competence | | | pintly solve technical problems, | and experim | nentally validat |
| Autonomy | their controller designs Students can obtain information from provided sources (lecture notes, software documentati experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress | | | | |
| Workload in Hours | Independent Stud | Time 124, Study Time | in Lecture 56 | | |
| Credit points | | | | | |
| Studienleistung | | | | | |
| Examination | | | | | |
| Examination duration and scale | | | | | |



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

General Engineering Science (English program): Core qualification: Compulsory

Assignment for the General Englowing Curricula Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory



Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective

Compulsory

Process Engineering: Core qualification: Compulsory

| Course L0654: Introduct | ion to Control Systems |
|-------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. Herbert Werner |
| Language | DE |
| Cycle | WiSe |
| Content | Signals and systems Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle Root locus techniques Root locus design of PID controllers Frequency response techniques Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation |
| | Frequency response interpretation of PID control Time delay systems Root locus and frequency response of time delay systems Smith predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course |
| Literature | Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems' Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010 |



| Course L0655: Introduction to Control Systems | | |
|---|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Herbert Werner | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | |
|-------------------------------|---|----------------------------------|----------------|-----------------|
| Title | | Тур | Hrs/wk | СР |
| Production Engineering I (L0 | 608) | Lecture | 2 | 2 |
| Production Engineering I (L0 | • | Recitation Section (large | | 1 |
| Production Engineering II (L0 | | Lecture | 2 | 2 |
| Production Engineering II (LC | 0611) | Recitation Section (large |) 1 | 1 |
| Module Responsible | Prof. Wolfgang Hintze | | | |
| Admission Requirements | None | | | |
| Recommended | no course assessments required internship recommended | | | |
| | | | | |
| - | After taking part successfully, students have | e reached the following learning | ng results | |
| Professional | | | | |
| Competence | Students are able to | | | |
| Knowledge | name basic criteria for the selection of manufacturing processes. name the main groups of Manufacturing Technology. name the application areas of different manufacturing processes. | | | |
| Skills | Students are able to select manufacturing processes in accordance with the requirements. design manufacturing processes for simple tasks to meet the required tolerances of th component to be produced. assess components in terms of their production-oriented construction. | | | |
| Personal Competence | | | | |
| - | Students are able to | | | |
| Social Competence | develop solutions in a production represent decisions. | environment with qualified pe | rsonnel at tec | hnical level ar |
| Autonomy | Students are able to • interpret independently the manufacturing process. • assess own strengths and weaknesses in general. • assess their learning progress and define gaps to be improved. • assess possible consequences of their actions. | | | |
| Workload in Hours | Independent Study Time 96, Study Time in | Lecture 84 | | |
| Credit points | · | | | |
| Studienleistung | | | | |
| | Written exam | | | |



| and scale | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
|---------------------|--|
| | Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Elective Compulsory |
| Following Curricula | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory |
| | Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory Mechanical Engineering: Core qualification: Compulsory |
| | Mechatronics: Core qualification: Compulsory |

| Course L0608: Production | on Engineering I | |
|--------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Wolfgang Hintze | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Manufacturing Accuracy Manufacturing Metrology Measurement Errors and Uncertainties Introduction to Forming Massiv forming and Sheet Metal Forming Introduction to Machining Technology Geometrically defined machining (Turning, milling, drilling, broaching, planning) | |
| Literature | Dubbel, Heinrich (Grote, Karl-Heinrich.; Feldhusen, Jörg.; Dietz, Peter.; Ziegmann, Gerhard Taschenbuch für den Maschinenbau : mit Tabellen. Berlin [u.a.] : Springer, 2007 Fritz, Alfred Herbert: Fertigungstechnik : mit 62 Tabellen. Berlin [u.a.] : Springer, 2004 Keferstein, Claus P (Dutschke, Wolfgang,;): Fertigungsmesstechnik : praxisorientierte Grundlage moderne Messverfahren. Wiesbaden : Teubner, 2008 Mohr, Richard: Statistik für Ingenieure und Naturwissenschaftler : Grundlagen und Anwendurstatistischer Verfahren. Renningen : expert-Verl, 2008 Klocke, F., König, W.: Fertigungsverfahren Bd. 1 Drehen, Fäsen, Bohren. 8. Aufl., Springer (2008) Klocke, Fritz (König, Wilfried,;): Umformen. Berlin [u.a.] : Springer, 2006 Paucksch, E.: Zerspantechnik, Vieweg-Verlag, 1996 Tönshoff, H.K.; Denkena, B., Spanen. Grundlagen, Springer-Verlag (2004) | |

| Course L0612: Production Engineering I | | |
|--|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Wolfgang Hintze | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Course L0610: Production Engineering II | | | |
|---|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Wolfgang Hintze, Prof. Claus Emmelmann | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Geometrically undefined machining (grinding, lapping, honing) Introduction into erosion technology Introduction into blastig processes Introduction to the manufacturing process forming (Casting, Powder Metallurgy, Composites) Fundamentals of Laser Technology Process versions and Fundamentals of Laser Joining Technology | | |
| Literature | Klocke, F., König, W.: Fertigungsverfahren Bd. 2 Schleifen, Honen, Läppen, 4. Aufl., Springer (2005) Klocke, F., König, W.: Fertigungsverfahren Bd. 3 Abtragen, Generieren und Lasermaterialbearbeitung 4. Aufl., Springer (2007) Spur, Günter (Stöferle, Theodor.;): Urformen. München [u.a.]: Hanser, 1981 Schatt, Werner (Wieters, Klaus-Peter,; Kieback, Bernd,;): Pulvermetallurgie: Technologien und Werkstoffe. Berlin [u.a.]: Springer, 2007 | | |

| Course L0611: Production Engineering II | | |
|---|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Wolfgang Hintze, Prof. Claus Emmelmann | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | |
|---|---|--|------------------|-----------------|
| Simulation and Design of Me | echatronic Systems (L1822) echatronic Systems (L1823) echatronic Systems (L1824) | Typ Lecture Recitation Section (large) Practical Course | Hrs/wk 2 1 | CP 2 2 2 |
| Module Responsible | 1 | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Fundatmentals of machanics, control theory and electrical engineering | | | |
| Educational Objectives | After taking part successfully, students have | e reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Students are able to describe methods optimization of mechatronic systems. | Students are able to describe methods and calculations for design, modeling, simulation an optimization of mechatronic systems. | | |
| Skills | | Students are able to apply modern algorithms for modeling of mechatronic systems. They can identify simulate and design simple systems and implement those in laboratory conditions. | | |
| Personal Competence | | | | |
| Social Competence | Ctudente ave able to week seel eviented in | small mixed groups and present | results to ta | rget groups. |
| | Students are able to recognize and improve | e knowledge deficits independer | ntly. | |
| Autonomy | With instructor assistance, students are able to evaluate their own knowledge level and define further course of study. | | | |
| Workload in Hours | Independent Study Time 124, Study Time in | n Lecture 56 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| | Written exam | | | |
| Examination duration and scale | 90 min | | | |
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Theoretical Mechanical Engineering: Elective Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Theoretical Mechanical Engineering: Elective Compulsory | | | |



Mechanical Engineering: Specialisation Mechatronics: Compulsory Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory Mechatronics: Core qualification: Compulsory

| Course L1822: Simulation and Design of Mechatronic Systems | | |
|--|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Uwe Weltin | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Mechatronic Design Modeling Model Identifikation Numerical Methods in simulation Applications and examples in Matlab® and Simulink® | |
| Literature | Skript zur Veranstaltung Weitere Literatur in der Veranstaltung | |

| Course L1823: Simulation and Design of Mechatronic Systems | | |
|--|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Uwe Weltin | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L1824: Simulation and Design of Mechatronic Systems | | |
|--|---|--|
| Тур | Practical Course | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Uwe Weltin | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0854: Ma | thematics IV | | | |
|--|--|---|-------------|----------------|
| Courses | | | | |
| | | T | Han bada | OD |
| Title Differential Equations 2 (Par | tial Differential Equations (1 1043) | Typ Lecture | Hrs/wk 2 | CP 1 |
| Differential Equations 2 (Partial Differential Equations) (L1043) Differential Equations 2 (Partial Differential Equations) (L1044) | | Recitation Section (small) | 1 | 1 |
| | tial Differential Equations) (L1045) | Recitation Section (large) | 1 | 1 |
| Complex Functions (L1038) | | Lecture | 2 | 1 |
| Complex Functions (L1041) | | Recitation Section (small) | 1 | 1 |
| Complex Functions (L1042) | | Recitation Section (large) | 1 | 1 |
| Module Responsible | | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Mathematics 1 - III | | | |
| Educational Objectives | After taking part successfully, students hav | re reached the following learning | results | |
| Professional | | | | |
| Competence | | | | |
| Knowledge | Students can name the basic concepts in Mathematics IV. They are able to explain them using appropriate examples. Students can discuss logical connections between these concepts. They are capable of illustrating these connections with the help of examples. They know proof strategies and can reproduce them. | | | |
| Skills | Students can model problems in Mathematics IV with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods. Students are able to discover and verify further logical connections between the concepts studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results. | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to work together in teams. They are capable to use mathematics as a common language. In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers. | | | |
| Autonomy | Students are capable of checking can specify open questions precise Students have developed sufficien oriented manner on hard problems | ely and know where to get help in t persistence to be able to work f | solving the | m. |
| Workload in Hours | Independent Study Time 68, Study Time in | Lecture 112 | | |
| Credit points | 6 | | | |
| Studienleistung | | | | |
| | Written exam | | | |
| Examination duration | | iovential Faurtiers O | | |
| and scale | 60 min (Complex Functions) + 60 min (Diff | erential Equations 2) | | |
| | | | | |



General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus

General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory

Assignment for the Following Curricula

Mechatronics: Compulsory
General Engineering Science (English program): Specialisation Mechanical Engineering, Focus

Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Specialisation Mechatronics: Compulsory

Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective

Compulsory



| Course L1043: Differential Equations 2 (Partial Differential Equations) | | | |
|---|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 1 | | |
| Workload in Hours | ndependent Study Time 2, Study Time in Lecture 28 | | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Main features of the theory and numerical treatment of partial differential equations Examples of partial differential equations First order quasilinear differential equations Normal forms of second order differential equations Harmonic functions and maximum principle Maximum principle for the heat equation Wave equation Liouville's formula Special functions Difference methods Finite elements | | |
| Literature | http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html | | |

| Course L1044: Differential Equations 2 (Partial Differential Equations) | | |
|---|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L1045: Differential Equations 2 (Partial Differential Equations) | | |
|---|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Course L1038: Complex Functions | | |
|---------------------------------|--|--|
| Тур | ecture | |
| Hrs/wk | 2 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Main features of complex analysis Functions of one complex variable Complex differentiation Conformal mappings Complex integration Cauchy's integral theorem Cauchy's integral formula Taylor and Laurent series expansion Singularities and residuals Integral transformations: Fourier and Laplace transformation | |
| Literature | http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html | |

| Course L1041: Complex Functions | | |
|---------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L1042: Complex Functions | |
|---------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M0829: Fo | oundations of Management | | | |
|-----------------------------------|--|---------------------------------------|-------------|----------------|
| | and the first of management | | | |
| Courses | | | | |
| Title Management Tutorial (L088) | 2) | Typ Recitation Section (large) | Hrs/wk 2 | CP 3 |
| Introduction to Management | | Lecture | 3 | 3 |
| Module Responsible | Prof. Christoph Ihl | | | |
| Admission Requirements | INONE | | | |
| Recommended Previous Knowledge | | S | | |
| Educational Objectives | After taking part successfully, students have rea | ached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | After taking this module, students know the important basics of many different areas in Business and Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects describe and explain basic business functions as production, procurement and sourcing supply chain management, organization and human ressource management, information management, innovation management and marketing explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance state basics from accounting and costing and selected controlling methods. | | | |
| Skills | Students are able to analyse business units with respect to different criteria (organization, objectives strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to • analyse Management goals and structure them appropriately • analyse organisational and staff structures of companies • apply methods for decision making under multiple objectives, under uncertainty and under risk • analyse production and procurement systems and Business information systems • analyse and apply basic methods of marketing • select and apply basic methods from mathematical finance to predefined problems • apply basic methods from accounting, costing and controlling to predefined problems | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a cohere | | | |
| Autonomy | Students are able to work in a team and to organize the team to write a report on their project. | n themselves | | |
| | Independent Study Time 110, Study Time in Le | cture 70 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| Examination | Subject theoretical and practical work | | | |
| Examination duration | | | | |



and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

Assignment for the Following Curricula

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:



Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

| Course L0882: Management Tutorial | | |
|-----------------------------------|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Christoph Ihl, Katharina Roedelius, Tobias VIcek | |
| Language | DE | |
| Cycle | WiSe/SoSe | |
| Content | In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools. If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on self-selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the business knowledge from the lecture should come to practical use. The group projects are guided by a mentor. | |
| Literature | Relevante Literatur aus der korrespondierenden Vorlesung. | |



| ourse L0880: Introduct | ion to Management | | |
|------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 3 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | |
| Lecturer | Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona | | |
| Language | DE | | |
| Cycle | WiSe/SoSe | | |
| Content | Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects | | |
| Literature | Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006. | | |



Specialization Biomedical Engineering

The requirements into the health system increase continuously due to the aging population and the increasing expectations for the quality in life. A major aspect in this development is medical technology. This ranges from individual implants and prostheses to complex imaging and therapy equipment and its operation. Medical specialists and well educated engineers will have to cooperate closer and closer to understand the requirements from either side and develop solutions together. In order to cooperate, the engineers need in addition to their core engineering skills, a basic understanding of the "other" fields, which are Medicine and Economy. This enables them to understand operational planning as well as research and development in this highly interdisciplinary area. The program is aimed towards allowing the students to achieve these qualifications.

| Module M0933: Fu | ndamentals of Materials So | cience | | |
|-----------------------------------|---|-------------------------------------|--------------|----|
| | | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Fundamentals of Materials S | science I (L1085) Science II (Advanced Ceramic Materials | Lecture Polymers and | 2 | 2 |
| Composites) (L0506) | Colonido II (Navanoca Ceramio Materiale | Lecture | 2 | 2 |
| Physical and Chemical Basi | cs of Materials Science (L1095) | Lecture | 2 | 2 |
| Module Responsible | Prof. Jörg Weißmüller | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Highschool-level physics, chemistry | und mathematics | | |
| Educational Objectives | After taking part successfully, studen | nts have reached the following lear | ning results | |
| Professional Competence | | | | |
| Knowledge | The students have acquired a fundamental knowledge on metals, ceramics and polymers and car describe this knowledge comprehensively. Fundamental knowledge here means specifically the issues of atomic structure, microstructure, phase diagrams, phase transformations, corrosion and mechanical properties. The students know about the key aspects of characterization methods for materials and can identify relevant approaches for characterizing specific properties. They are able to trace materials phenomena back to the underlying physical and chemical laws of nature. | | | |
| Skills | The students are able to trace materials phenomena back to the underlying physical and chemical laws of nature. Materials phenomena here refers to mechanical properties such as strength, ductility, and stiffness, chemical properties such as corrosion resistance, and to phase transformations such as solidification, precipitation, or melting. The students can explain the relation between processing conditions and the materials microstructure, and they can account for the impact of microstructure on the material's behavior. | | | |
| Personal Competence | | | | |
| Social Competence | - | | | |
| Autonomy | <u>-</u> | | | |
| Workload in Hours | Independent Study Time 96, Study T | ime in Lecture 84 | | - |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 180 min | | | |



| | General Engineering Science (German program): Specialisation Energy and Environmental |
|---------------------|---|
| | Engineering: Compulsory |
| | General Engineering Science (German program): Specialisation Mechanical Engineering: |
| | Compulsory |
| | General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory |
| | General Engineering Science (German program): Specialisation Naval Architecture: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: |
| | Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: |
| | Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Energy and |
| | Environmental Engineering: Compulsory |
| | Energy and Environmental Engineering: Core qualification: Compulsory |
| | General Engineering Science (English program): Specialisation Energy and Environmental |
| Assignment for the | Engineering: Compulsory |
| Following Curricula | General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory |
| | General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory |
| | General Engineering Science (English program): Specialisation Naval Architecture: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental |
| | Engineering: Compulsory |
| | Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory |
| | Mechanical Engineering: Core qualification: Compulsory |
| | Mechatronics: Core qualification: Compulsory |
| | Naval Architecture: Core qualification: Compulsory |
| | Technomathematics: Specialisation III. Engineering Science: Elective Compulsory |

| Course L1085: Fundamentals of Materials Science I | | |
|---|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Jörg Weißmüller | |
| Language | DE | |
| Cycle | WiSe | |
| Content | | |
| Literature | Vorlesungsskript W.D. Callister: Materials Science and Engineering - An Introduction. 5th ed., John Wiley & Sons, Inc. New York, 2000, ISBN 0-471-32013-7 | |



| Course L0506: Fundame | Course L0506: Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) | | |
|-----------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Bodo Fiedler, Prof. Gerold Schneider | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Chemische Bindungen und Aufbau von Festkörpern; Kristallaufbau; Werkstoffprüfung; Schweißbarkeit; Herstellung von Keramiken; Aufbau und Eigenschaften der Keramik; Herstellung, Aufbau und Eigenschaften von Gläsern; Polymerwerkstoffe, Makromolekularer Aufbau; Struktur und Eigenschaften der Polymere; Polymerverarbeitung; Verbundwerkstoffe | | |
| Literature | Vorlesungsskript W.D. Callister: Materials Science and Engineering -An Introduction-5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7 | | |

| Тур | Lecture | | |
|-------------------|---|--|--|
| Hrs/wk | | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Stefan Müller | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Motivation: "Atoms in Mechanical Engineering?" Basics: Force and Energy The electromagnetic Interaction "Detour": Mathematics (complex e-funktion etc.) The atom: Bohr's model of the atom Chemical bounds The multi part problem: Solutions and strategies Descriptions of using statistical thermodynamics Elastic theory of atoms Consequences of atomar properties on makroskopic Properties: Discussion of example (metals, semiconductors, hybrid systems) | | |
| Literature | Für den Elektromagnetismus: Bergmann-Schäfer: "Lehrbuch der Experimentalphysik", Band 2: "Elektromagnetismus", ogruyter Für die Atomphysik: Haken, Wolf: "Atom- und Quantenphysik", Springer Für die Materialphysik und Elastizität: Hornbogen, Warlimont: "Metallkunde", Springer | | |



| Courses | | | | | |
|----------------------------------|--|---|--|--|------------------|
| Title Computer Engineering (L032 | | | Typ Lecture | Hrs/wk | CP 4 |
| Computer Engineering (L032 | <u> </u> | | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Heiko Falk | | | | |
| Requirements | None | | | | |
| | examination according to 1. Upon a passed marks due to the respectively, up to | etion of the labs will be the following rules: module examination as successful labs, sue the next-better grade | I be honored during the of the student is granted a back that the examination's me. o 4,3 and of 4,3 up to 4,0 is not be a state of 4,3 up to 4,0 is not be a state of 4.3 up to 4.0 is not be a state of 4.0 is not be a state of 4.3 up to 4.0 is not be a state of 4.0 is not be a st | oonus on the arks are lifte | e examination's |
| Educational Objectives | After taking part success | fully, students have re | eached the following learning | g results | |
| Professional Competence | | | | | |
| Competence | This module deals with | the foundations of th | e functionality of computing | evetome It o | overe the layer |
| Knowledge | Introduction Combinational Incombinational Incombinational Incombinational Incombinational Incombinational Incombination Incombina | ogic: Gates, Boole. etworks Flip-flops, automata, undations etic: Integer addition, outer architecture: F | o gates. The module includes an algebra, Boolean functions systematic hardware design subtraction, multiplication and trogramming models, MIPS 1, DRAM, caches a of the CPU, principles of | tions, hardv d division s single-cyc | vare synthesis |
| Skills | The students perceive computer systems from the architect's perspective, i.e., they identify the interr structure and the physical composition of computer systems. The students can analyze, how high specific and individual computers can be built based on a collection of few and simple component. They are able to distinguish between and to explain the different abstraction layers of toda computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependence between a physical computer system and the software executed on it. In particular, they shounderstand the consequences that the execution of software has on the hardware-centric abstractillayers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to propose feasible options. | | yze, how highly le components yers of today! erdependencies ular, they shain tric abstraction to evaluate the | | |
| Personal Competence | | | | | |
| Social Competence | Students are able to solv | ve similar problems a | one or in a group and to pres | sent the resu | Its accordingly. |
| | Students are able to accomit other classes. | quire new knowledge | from specific literature and | to associate | this knowledge |
| Workload in Hours | Independent Study Time | 124, Study Time in L | ecture 56 | | |
| Credit points | | <u>-</u> | | | |
| | Compulsory Bonus | Form | Description | | |



| Examination duration and scale | 90 minutes, contents of course and labs |
|--------------------------------|---|
| | General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and |
| | Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Energy Systems: Compulsory Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory |
| | General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental |
| | Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory |
| | Focus Energy Systems: Compulsory |



Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory

| Course L0321: Compute | r Engineering |
|-----------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Heiko Falk |
| Language | DE |
| Cycle | WiSe |
| Content | Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output |
| Literature | A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. |

| Course L0324: Computer Engineering | | |
|------------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | |
|--|---|---------------------------------------|--------------|-----------------|
| Title | | Тур | Hrs/wk | CP |
| Fluid Mechanics (L0454) Fluid Mechanics (L0455) | | Lecture Recitation Section (large) | 3 2 | 4 2 |
| Module Responsible | Prof. Thomas Rung | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Sound knowledge of engineering mathemati | cs, engineering mechanics an | d thermodyr | amics. |
| Educational Objectives | After taking part successfully, students have i | eached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Students will have the required sound knowledge to explain the general principles of fluid engineering and physics of fluids. Students can scientifically outline the rationale of flow physics using | | | |
| Skills | Students are able to apply fluid-engineering technical systems. The lecture enables the story the fluid dynamic design of engineering d | student to carry out all necess | | |
| Personal Competence | The students are able to discuss problems a | nd jointly develop solution stra | tegies. | |
| Social Competence | · | , , , | J | |
| Autonomy | The students are able to develop solution stranglyse results. | ategies for complex problems | self-consist | ent and crtical |
| Workload in Hours | Independent Study Time 110, Study Time in | _ecture 70 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 180 min | | | |
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Mechanical Engineering: Core qualification: Compulsory | | | |



Naval Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

| Course L0454: Fluid Med | chanics |
|-------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Thomas Rung |
| Language | DE |
| Cycle | SoSe |
| Content | Overview Physical/mathematical modelling Special phenomena Basic equations of fluid dynamics The turbulence problem One dimensional theory for inkompressibel flows One dimensional theory for kompressibel flows Flow over contours without friction Flow over contours with friction Flow through channels Simplified equations for three dimensional flow Special aspects of the numerical solution for complex flows |
| Literature | Herwig, H.: Strömungsmechanik, 2. Auflage, Springer- Verlag, Berlin, Heidelberg, 2006 Herwig, H.: Strömungsmechanik von A-Z, Vieweg Verlag, Wiesbaden, 2004 |

| Course L0455: Fluid Med | chanics |
|-------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Thomas Rung |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| f. Gerhard Bauch the matics 1-3 modul is an introduction to the theory ered by the moduls Mathematik 1-3 is every ered by the moduls Mathematically, students have every extended by the module of signal and system theory. The tinuous-time and discrete-time signals and and systems mathematically in both locts in time domain and image domain and to a discrete-time signal. The students are able to describe and analysis in the signal and system theory or tant properties such as magnitude and impact of LTI systems on the signal properties students can jointly solve specific problem. | reached the following learning reached to apply the fund and systems. They can describe time and image domain. In particular the following reached the following reached reac | variant (LTI) lamental trane and analys rticular, they insition of a conear time-invigor basic systearity etc The | systems using sformations of the deterministic understand the ontinuous-time variant systems regarding |
|--|--|--|--|
| thematics 1-3 modul is an introduction to the theory ered by the moduls Mathematik 1-3 is equrier series, Fourier transform, Laplace tractions are able to classify and described of signal and system theory. The tinuous-time and discrete-time signals and als and systems mathematically in both locts in time domain and image domain and to a discrete-time signal. The students are able to describe and analysing methods of signal and system theory ortant properties such as magnitude and impact of LTI systems on the signal properties students can jointly solve specific probles. | Lecture Recitation Section (small) of signals and systems. Googreeted. Further experience was ansform) is useful but not require the signals and linear time-inguise signals and linear time-inguise and image domain. In particular and image and linear time and linear time and linear time and linear time-inguise and linear time and linear time-inguise deterministic signals and linear time and linear time and linear time-inguise and linear time and linear time-inguise and linear time and linear time-inguise and linear time-inguise and linear time-inguise and linear time and linear time-inguise | od knowledg vith spectral t ired. results variant (LTI) amental tranee and analys rticular, they of a content time-inversion of a content time-inversion basic systems arity etc The | systems using asformations of the deterministic understand the ontinuous-time variant systems regarding |
| thematics 1-3 modul is an introduction to the theory ered by the moduls Mathematik 1-3 is equrier series, Fourier transform, Laplace tractions are able to classify and described of signal and system theory. The tinuous-time and discrete-time signals and als and systems mathematically in both locts in time domain and image domain and to a discrete-time signal. The students are able to describe and analysing methods of signal and system theory ortant properties such as magnitude and impact of LTI systems on the signal properties students can jointly solve specific probles. | Lecture Recitation Section (small) of signals and systems. Googreeted. Further experience was ansform) is useful but not require the signals and linear time-inguise signals and linear time-inguise and image domain. In particular and image and linear time and linear time and linear time and linear time-inguise and linear time and linear time-inguise deterministic signals and linear time and linear time and linear time-inguise and linear time and linear time-inguise and linear time and linear time-inguise and linear time-inguise and linear time-inguise and linear time and linear time-inguise | od knowledg vith spectral t ired. results variant (LTI) amental tranee and analys rticular, they of a content time-inversion of a content time-inversion basic systems arity etc The | systems using asformations of the deterministic understand the ontinuous-time variant systems regarding |
| thematics 1-3 modul is an introduction to the theory ered by the moduls Mathematik 1-3 is equrier series, Fourier transform, Laplace tractions are able to classify and described of signal and system theory. The tinuous-time and discrete-time signals and als and systems mathematically in both locts in time domain and image domain and to a discrete-time signal. The students are able to describe and analysing methods of signal and system theory ortant properties such as magnitude and impact of LTI systems on the signal properties students can jointly solve specific probles. | Recitation Section (small) of signals and systems. Government of signals and systems and systems of specific to the signals and linear time-inguished systems. They can describe time and image domain. In particular are caused by the transport of the signals and limited and systems. They can describe time and image domain. In particular are caused by the transport of the signals and limited and systems. They can analyse and designals are specifications of the signals and limited and systems. | od knowledg with spectral to the spectral to t | systems using asformations of the deterministic understand the ontinuous-time variant systems regarding |
| thematics 1-3 modul is an introduction to the theory ered by the moduls Mathematik 1-3 is equrier series, Fourier transform, Laplace tractions are able to classify and described of signal and system theory. The tinuous-time and discrete-time signals and als and systems mathematically in both locts in time domain and image domain and to a discrete-time signal. The students are able to describe and analysing methods of signal and system theory ortant properties such as magnitude and impact of LTI systems on the signal properties students can jointly solve specific probles. | reached the following learning reached to apply the fund and systems. They can describe time and image domain. In particular the following reached the following reached reac | variant (LTI) lamental trane and analys rticular, they insition of a conear time-invigor basic systearity etc The | systems using sformations of the deterministic understand the ontinuous-time variant systems regarding |
| e modul is an introduction to the theory ered by the moduls Mathematik 1-3 is e urier series, Fourier transform, Laplace treat taking part successfully, students have estudents are able to classify and described of signal and system theory. The tinuous-time and discrete-time signals and systems mathematically in both locts in time domain and image domain and to a discrete-time signal. The students are able to describe and analysing methods of signal and system theory ortant properties such as magnitude and impact of LTI systems on the signal properties students can jointly solve specific problems. | reached the following learning reached to apply the fund and systems. They can describe time and image domain. In particular the following reached the following reached reac | variant (LTI) lamental trane and analys rticular, they insition of a conear time-invigor basic systearity etc The | systems using sformations of the deterministic understand the ontinuous-time variant systems regarding |
| e modul is an introduction to the theory ered by the moduls Mathematik 1-3 is equrier series, Fourier transform, Laplace transf | reached the following learning reached to apply the fund and systems. They can describe time and image domain. In particular the following reached the following reached reac | variant (LTI) lamental trane and analys rticular, they insition of a conear time-invigor basic systearity etc The | systems using sformation of the continuous systems and the continuous system on the continuous system on the continuous system of the continuous s |
| ered by the moduls Mathematik 1-3 is equirier series, Fourier transform, Laplace transfor | reached the following learning reached to apply the fund and systems. They can describe time and image domain. In particular the following reached the following reached reac | variant (LTI) lamental trane and analys rticular, they insition of a conear time-invigor basic systearity etc The | systems using stormation of the systems using the system of the system on tinuous time on tinuous time or tinuous time of the system of the sy |
| e students are able to classify and describods of signal and system theory. The tinuous-time and discrete-time signals anals and systems mathematically in both cts in time domain and image domain hal to a discrete-time signal. The students are able to describe and analying methods of signal and system theory ortant properties such as magnitude and impact of LTI systems on the signal properstudents can jointly solve specific problems. | ribe signals and linear time-in y are able to apply the fund and systems. They can describe time and image domain. In part which are caused by the transese deterministic signals and list. They can analyse and designate and the carries in time and frequency downs. | variant (LTI) lamental tran e and analys rticular, they of sition of a connear time-inv gn basic syst earity etc Th | esformations of the deterministic understand the continuous-time variant system tems regarding |
| thods of signal and system theory. The tinuous-time and discrete-time signals an als and systems mathematically in both cts in time domain and image domain and to a discrete-time signal. It is students are able to describe and analying methods of signal and system theory ortant properties such as magnitude and impact of LTI systems on the signal proper students can jointly solve specific problems. | y are able to apply the fund nd systems. They can describe time and image domain. In part which are caused by the transfer deterministic signals and lit. They can analyse and design phase response, stability, line erties in time and frequency domain. | amental trane and analys rticular, they usition of a conear time-invented by the control of the | nsformations of the deterministic understand the continuous-time variant system tems regarding |
| thods of signal and system theory. The tinuous-time and discrete-time signals an als and systems mathematically in both cts in time domain and image domain and to a discrete-time signal. It is students are able to describe and analying methods of signal and system theory ortant properties such as magnitude and impact of LTI systems on the signal proper students can jointly solve specific problems. | y are able to apply the fund nd systems. They can describe time and image domain. In part which are caused by the transfer deterministic signals and lit. They can analyse and design phase response, stability, line erties in time and frequency domain. | amental trane and analys rticular, they usition of a conear time-invented by the control of the | nsformations of the deterministic understand the continuous-time variant system tems regarding |
| ng methods of signal and system theory ortant properties such as magnitude and impact of LTI systems on the signal properties students can jointly solve specific problem. | . They can analyse and design phase response, stability, line orties in time and frequency downs. | gn basic syst earity etc Th | ems regarding |
| | | | |
| | | | |
| | | | |
| e students are able to acquire relevant trol their level of knowledge during the ker system. | nformation from appropriate li ecture period by solving tutori | | • |
| ependent Study Time 110, Study Time in | Lecture 70 | | |
| | | | |
| ne | | | |
| tten exam | | | |
| min | | | |
| neral Engineering Science (German progneral Engineering Science (Germa | ram): Specialisation Process E ram): Specialisation Bioproces program): Specialisation program): Specialisation ram): Specialisation Biomedica gram, 7 semester): Specialisation ogram, 7 semester): Specialisation ram, 7 semester): Specialisation | Engineering: (ss Engineerin Civil- and Mechanical al Engineerin tion Electrical isation Compation Proces on Bioproces on Biomedical | Compulsory ng: Compulsor Enviromenta Engineering ng: Compulsor al Engineering puter Science s Engineering ss Engineering |
| _tt | eral Engineering Science (German progeral Engineering Science (German eneering: Compulsory eral Engineering Science (German progeral Engineering Science (Germa | eral Engineering Science (German program): Specialisation Electrical eral Engineering Science (German program): Specialisation Computer eral Engineering Science (German program): Specialisation Process E eral Engineering Science (German program): Specialisation Bioproces eral Engineering Science (German program): Specialisation Bioproces eral Engineering Science (German program): Specialisation eneering: Compulsory eral Engineering Science (German program): Specialisation inpulsory eral Engineering Science (German program): Specialisation Biomedical Engineering Science (German program, 7 semester): Specialisation pulsory eral Engineering Science (German program, 7 semester): Specialisation pulsory eral Engineering Science (German program, 7 semester): Specialisation pulsory eral Engineering Science (German program, 7 semester): Specialisation pulsory eral Engineering Science (German program, 7 semester): Specialisation pulsory eral Engineering Science (German program, 7 semester): Specialisation pulsory | eral Engineering Science (German program): Specialisation Electrical Engineering eral Engineering Science (German program): Specialisation Computer Science: Coeral Engineering Science (German program): Specialisation Process Engineering: eral Engineering Science (German program): Specialisation Bioprocess Engineering eral Engineering Science (German program): Specialisation Civil- and eneering: Compulsory eral Engineering Science (German program): Specialisation Mechanical engulsory eral Engineering Science (German program): Specialisation Biomedical Engineering eral Engineering Science (German program, 7 semester): Specialisation Electrical engulsory eral Engineering Science (German program, 7 semester): Specialisation Compulsory eral Engineering Science (German program, 7 semester): Specialisation Proces engulsory eral Engineering Science (German program, 7 semester): Specialisation Bioproces engulsory eral Engineering Science (German program, 7 semester): Specialisation Bioproces engulsory eral Engineering Science (German program, 7 semester): Specialisation Bioproces engulsory eral Engineering Science (German program, 7 semester): Specialisation Bioproces engulsory eral Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Science (German program, 7 semester): |



Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Theoretical Mechanical Engineering: Compulsory

Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:

Compulsory

Assignment for the

Following Curricula

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



| Course L0432: Signals a | and Systems |
|-------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | |
| | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer Language | Prof. Gerhard Bauch |
| Cycle | |
| Content | Basic classification and description of continuous-time and discrete-time signals and systems Concvolution Power and energy of signals Correlation functions of deterministic signals Linear time-invariant (LTI) systems Signal transformations: Fourier-Series Fourier Transform Laplace Transform Discrete-time Fourier Transform Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT) Z-Transform Analysis and design of LTI systems in time and frequency domain Basic filter types Sampling, sampling theorem Fundamentals of recursive and non-recursive discrete-time filters |
| Literature | T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004 K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag. B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997 J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002 S. Haykin, B. van Veen: Signals and systems. Wiley. Oppenheim, A.S. Willsky: Signals and Systems. Pearson. Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson. |



| Course L0433: Signals and Systems | | |
|-----------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Gerhard Bauch | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0960: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multib Systems) | ody |
|---|-----|
| 20111100 | |

| Солическ | | | |
|--|--|--|--|
| Courses | _ | | |
| Title | Typ | Hrs/wk | СР |
| (L1137) | Oscillations, Analytical Mechanics, Multibody Systems) Lecture | 3 | 3 |
| Mechanics IV (Kinetics II, (L1138) | Oscillations, Analytical Mechanics, Multibody Systems) Recitation Section (sm | | 2 |
| Mechanics IV (Kinetics II, (L1139) | Oscillations, Analytical Mechanics, Multibody Systems) Recitation Section (large | ge) 1 | 1 |
| Module Responsible | Prof. Robert Seifried | | |
| Admission Requirements | None | | |
| Recommended Previous Knowledge | Mathematics I-III and Mechanics I-III | | |
| Educational Objectives | After taking part successfully, students have reached the following learn | ning results | |
| Professional | | | |
| Competence | | | |
| | The students can | | |
| Knowledge | describe the axiomatic procedure used in mechanical contexts; explain important steps in model design; present technical knowledge. | | |
| - | The students can | | |
| Skills | explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems; apply basic methods to engineering problems; estimate the reach and boundaries of the methods and extend them to be applicable to wider problem sets. | | |
| Personal Competence Social Competence | Students are capable of determining their own strengths and weakne | | ınize their time |
| Autonomy | and learning based on those. | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 | | |
| Credit points | 6 | | |
| Ctudioploiotupa | Compulsory Bonus Form Description | | |
| Studienleistung | No 20 % Midterm Wird nur im | SoSe angeboten | |
| Examination | Written exam | | |
| Examination duration and scale | 120 min | | |
| | General Engineering Science (German program): Specialisation Compulsory General Engineering Science (German program): Specialisation Biome General Engineering Science (German program): Specialisation Naval General Engineering Science (German program, 7 semester): Specialis Compulsory General Engineering Science (German program, 7 semester): Specialis Compulsory General Engineering Science (German program, 7 semester): Specialis Compulsory General Engineering Science (German program, 7 semester): Specialisation General Engineering Science (English program): Specialisation Mechan General Engineering Science (English program): Specialisation Biome | edical Engineerin Architecture: Co sation Mechanica sation Biomedica ecialisation Nava | g: Compulsory mpulsory al Engineering: al Engineering: al Architecture: g: Compulsory |

Compulsory



| General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory |
|---|
| General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: |
| Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: |
| Compulsory |
| Mechanical Engineering: Core qualification: Compulsory |
| Mechatronics: Core qualification: Compulsory |
| Naval Architecture: Core qualification: Compulsory |
| Technomathematics: Specialisation III. Engineering Science: Elective Compulsory |
| Technomathematics: Core qualification: Elective Compulsory |
| Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective |

| Course L1137: Mechanic | cs IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) |
|------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Prof. Robert Seifried |
| Language | DE |
| Cycle | SoSe |
| Content | Simple impact problems Principles of analytical mechanics Elements of vibration theory Vibration of Multi-degree of freedom systems Multibody Systems Numerical methods for time integration Introduction to Matlab |
| Literature | K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011). W. Schiehlen, P. Eberhard: Technische Dynamik, Springer (2012). |

| Course L1138: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) | |
|---|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Robert Seifried |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Course L1139: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) | |
|---|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Robert Seifried |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M1277: ME | ED I: Introduction to Anatomy | | |
|--|--|--------------------------|---|
| Courses | | | |
| Title Introduction to Anatomy (L03) | Typ 384) Lecture | Hrs/wk C | ;P |
| Module Responsible | Prof. Udo Schumacher | | |
| Admission Requirements | | | |
| Recommended Previous Knowledge | None | | |
| Educational Objectives | After taking part successfully, students have reached the follow | ring learning results | |
| Professional Competence | | | |
| Knowledge | The students can describe basal structures and functions of i system. The students can describe the basic macroscopy and microscopy. | • | culoskeleta |
| Skills | The students can recognize the relationship between given anatomical facts and the development of some common diseases; they can explain the relevance of structures and their functions in the context of widespread diseases. | | |
| Personal Competence | | | |
| Social Competence | The students can participate in current discussions in bio professional level. | medical research and med | dicine on a |
| Autonomy | The students are able to access anatomical knowledg conversations on the topic and acquire the relevant knowledge | | rticipate ir |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Credit points | 3 | | |
| Studienleistung | None | | |
| Examination | Written exam | | |
| Examination duration | 90 minutes | | |
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Mechanical Engineering, For Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsor General Engineering Science (English program): Specialisation Biomedical Engineering Science (English program): Specialisation Biomedical Engineering Science (English program): Specialisation Biomedical Engineering Science (English program): Specialisatio | | Compulsory Engineering Fring, Focus Compulsory Engineering Engineering Compulsory n: Elective |



| ourse L0384: Introduct | | | |
|------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | <u>-</u> | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| | Prof. Tobias Lange | | |
| Language | | | |
| Cycle | SoSe | | |
| Content | General Anatomy 1st week: The Eucaryote Cell 2nd week: The Tissues 3rd week: Cell Cycle, Basics in Development 4th week: Musculoskeletal System 5th week: Cardiovascular System 6th week: Respiratory System 7th week: Genito-urinary System 8th week: Immune system 9th week: Digestive System I 10th week: Digestive System II 11th week: Endocrine System 12th week: Nervous System 13th week: Exam | | |
| Literature | Adolf Faller/Michael Schünke, Der Körper des Menschen, 16. Auflage, Thieme Verlag Stuttgart, 2012 | | |



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|--|---|---------------------------------------|-----------------------|------------------|
| ourses | | | | |
| itle Itroduction to Radiology an | d Radiation Therapy (L0383) | Typ Lecture | Hrs/wk 2 | CP 3 |
| Module Responsible | Prof. Ulrich Carl | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | None | | | |
| | After taking part successfully, stude | nts have reached the following le | earning results | |
| Professional Competence | | | 3 | |
| | Therapy The students can distinguish diffe radiation therapy. | rent types of currently used eq | uipment with respe | ect to its use i |
| | The students can explain treatmen surgery, internal medicine). | t plans used in radiation therap | y in interdisciplina | ry contexts (e. |
| | The students can describe the pacare. | tients' passage from their initia | al admittance throu | ugh to follow-u |
| | Diagnostics | | | |
| Knowledge | The students can illustrate the angiography and mammography, a | · · · · · · · · · · · · · · · · · · · | - | |
| | The students can explain the diagr the technical basis for those technic | | of imaging technic | ques, as well a |
| | The students can choose the right needs. | treatment method depending of | on the patient's clin | ical history an |
| | The student can explain the influen | ce of technical errors on the imag | ging techniques. | |
| | The student can draw the right coprotocol. | onclusions based on the image | es' diagnostic findir | ngs or the erro |
| | Therapy The students can distinguish cura conclusion. | tive and palliative situations an | d motivate why the | ey came to the |
| | The students can develop adequate | e therapy concepts and relate it t | o the radiation biol | ogical aspects. |
| | The students can use the therapeut | ic principle (effects vs adverse e | ffects) | |
| | The students can distinguish differ situation (location of the tumor) and | | | |
| Skills | The student can assess what an treatment, sports, social help group | | | |
| | Diagnostics | | | |
| | The students can suggest solution analyses. | ns for repairs of imaging instru | mentation after ha | ving done erro |
| | The students can classify results based on their knowledge of anator | | - | ups of disease |
| Personal Competence | | | | |
| | | cial social situation of tumor pa | tients and interact | with them in |
| | professional way. | dai social situation of turnor pa | monto ana interact | With them in |



| | diagnostic and therapeutic measures and can meet them appropriately. |
|---|--|
| | The students can apply their new knowledge and skills to a concrete therapy case. The students can introduce younger students to the clinical daily routine. |
| Autonomy | The students are able to access anatomical knowledge by themselves, can participate competently in conversations on the topic and acquire the relevant knowledge themselves. |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Credit points | 3 |
| Studienleistung | None |
| Examination | Written exam |
| Examination duration and scale | 190 minutes |
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory |



| | Lecture |
|-------------------|--|
| Hrs/wk | |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| | Prof. Ulrich Carl, Prof. Thomas Vestring |
| Language | |
| Cycle Content | The students will be given an understanding of the technological possibilities in the field medical imaging, interventional radiology and radiation therapy/radiation oncology. It assumed, that students in the beginning of the course have heard the word "X-ray" at best will be distinguished between the two arms of diagnostic (Prof. Dr. med. Thomas Vestring) a |
| Literature | "Technik der medizinischen Radiologie" von T. + J. Laubenberg – 7. Auflage – Deutscher Ärzteverlag – erschienen 1999 "Klinische Strahlenbiologie" von Th. Herrmann, M. Baumann und W. Dörr – 4. Auflage - Verlag Urban & Fischer – erschienen 02.03.2006 ISBN: 978-3-437-23960-1 "Strahlentherapie und Onkologie für MTA-R" von R. Sauer – 5. Auflage 2003 - Verlag Urban & Schwarzenberg – erschien 08.12.2009 ISBN: 978-3-437-47501-6 "Taschenatlas der Physiologie" von S. Silbernagel und A. Despopoulu 8. Auflage – Georg Thieme Verlag - erschienen 19.09.2012 ISBN: 978-3-13-567708-8 "Der Körper des Menschen " von A. Faller u. M. Schünke - 16. Auflage 2004 – Georg Thieme Verlag – erschienen 18.07.2012 ISBN: 978-3-13-329716-5 "Praxismanual Strahlentherapie" von Stöver / Feyer – |



| Module M0598: Me | echanical Enginee | ring: Design | | | |
|-----------------------------------|--|--|------------------------------------|------------------|-----------|
| Courses | | | | | |
| Title Embodiment Design and 3D | -CAD (L0268) | | Typ Lecture | Hrs/wk | CP |
| Mechanical Design Project I | (L0695) | | Project-/problem-based Learning | 3 | 2 |
| Mechanical Design Project I | I (L0592) | | Project-/problem-based Learning | 3 | 2 |
| Team Project Design Metho | dology (L0267) | | Project-/problem-based Learning | 2 | 1 |
| Module Responsible | Prof. Dieter Krause | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | | | | | |
| Educational Objectives | After taking part success | sfully, students have reach | ed the following learning | results | |
| Professional Competence | | | | | |
| | After passing the module | e, students are able to: | | | |
| Knowledge | explain design guidelines for machinery parts e.g. considering load situation, materials ar manufacturing requirements, describe basics of 3D CAD, explain basics methods of engineering designing. | | | ı, materials and | |
| | After passing the module | e, students are able to: | | | |
| Skills | independently create sketches, technical drawings and documentations e.g. using 3D CAD, design components based on design guidelines autonomously | | | | |
| Personal Competence | ! ! | a atudanta ara abla ta: | | | |
| Social Competence | After passing the module, students are able to: • develop and evaluate solutions in groups including making and documenting decisions, • moderate the use of scientific methods, • present and discuss solutions and technical drawings within groups, • reflect the own results in the work groups of the course. | | | | |
| Autonomy | Students are able • to estimate their level of knowledge using activating methods within the lectures (e.g. with clickers), | | | | |
| | To solve engines | ering design tasks systema | atically. | | |
| Workload in Hours | Independent Study Time | e 40, Study Time in Lecture | e 140 | | |
| Credit points | 6 | | | | |
| Studienleistung | Yes None Yes None Yes None Yes None Yes None Yes None | Form Written elaboration Written elaboration Written elaboration Written elaboration | Description | | |
| Examination | Written exam | | | | |
| Examination duration | | | | | |



| and scale | 180 |
|---------------------|---|
| | General Engineering Science (German program): Specialisation Energy and Enviromental |
| | Engineering: Compulsory |
| | General Engineering Science (German program): Specialisation Mechanical Engineering: |
| | Compulsory |
| | General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: |
| | Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Energy and |
| | Environmental Engineering: Compulsory |
| | Energy and Environmental Engineering: Core qualification: Compulsory |
| Assignment for the | General Engineering Science (English program): Specialisation Energy and Environmental |
| Following Curricula | Engineering: Compulsory |
| | General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory |
| | General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental |
| | Engineering: Compulsory |
| | Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory |
| | Naval Architecture: Core qualification: Compulsory |
| | |

| urse L0268: Embodim | ent Design and 3D-CAD |
|---------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Prof. Dieter Krause |
| Language | DE |
| Cycle | WiSe |
| Content | Basics of 3D CAD technology Practical course to apply a 3D CAD system Introduction to the system Sketching and creation of components Creation of assemblies Deriving technical drawings |
| Literature | CAx für Ingenieure eine praxisbezogene Einführung; Vajna, S., Weber, C., Bley, H., Zeman, K. Springer-Verlag, aktuelle Auflage. Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage. Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H. Hesser, W; Cornelsen, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F. Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. |



| Course L0695: Mechanical Design Project I | | |
|---|--|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 3 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 18, Study Time in Lecture 42 | |
| Lecturer | Prof. Thorsten Schüppstuhl | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Create a technical documentation of an existing mechanical model Consolidation of the following aspects of technical drawings: Presentation of technical objects and standardized parts (bearings, seals, shaft-hub joints, detachable connections, springs, axes and shafts) Sectional views Dimensioning Tolerances and surface specifications Creating a tally sheet | |
| Literature | Hoischen, H.; Hesser, W.: Technisches Zeichnen. Grundlagen, Normen, Beispiele, darstellende Geometrie, 33. Auflage. Berlin 2011. Labisch, S.; Weber, C.: Technisches Zeichnen. Selbstständig lernen und effektiv üben, 4. Auflage. Wiesbaden 2008. Fischer, U.: Tabellenbuch Metall, 43. Auflage. Haan-Gruiten 2005. | |

| Course L0592: Mechanical Design Project II | | |
|--|---|--|
| | | |
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 3 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 18, Study Time in Lecture 42 | |
| Lecturer | Prof. Wolfgang Hintze | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Generation of sketches for functions and sub-functions Approximately calculation of shafts Dimension of bearings, screw connections and weld Generation of engineering drawings (assembly drawings, manufacturing drawing) | |
| Literature | Dubbel, Taschenbuch für Maschinenbau, Beitz, W., Küttner, KH, Springer-Verlag. Maschinenelemente, Band I - III, Niemann, G., Springer-Verlag. Maschinen- und Konstruktionselemente, Steinhilper, W., Röper, R., Springer-Verlag. Einführung in die DIN-Normen, Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G., Beitz, W., Springer-Verlag. | |



| Course L0267: Team Project Design Methodology | | |
|---|---|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 2 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | |
| Lecturer | Prof. Dieter Krause | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Introduction to engineering designing methodology Team Project Design Methodology Creating requirement lists Problem formulation Creating functional structures Finding solutions Evaluation of the found concepts Documentation of the taken methodological steps and the concepts using presentation slides | |
| Literature | Dubbel, Taschenbuch für den Maschinenbau; Grote, KH., Feldhusen, J.(Hrsg.); Springer-Verlag, aktuelle Auflage. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Maschinen- und Konstruktionselemente; Steinhilper, W., Röper, R., Springer Verlag, aktuelle Auflage. Einführung in die DIN-Normen; Klein, M., Teubner-Verlag. Konstruktionslehre, Pahl, G.; Beitz, W., Springer-Verlag, aktuelle Auflage. Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, aktuelle Auflage. Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. Sowie weitere Bücher zu speziellen Themen | |



| Courses | | | | | |
|--|--|--|--|---|--|
| Γitle | | Тур | Hrs/wk | СР | |
| Numerical Mathematics I (LC Numerical Mathematics I (LC | , | Lecture Recitation Section (small) | 2 2 | 3 3 | |
| Module Responsible | Prof. Sabine Le Borne | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | Il for Technomathematicians | | | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | | |
| Professional Competence | | | | | |
| | Students are able to | | | | |
| Knowledge | name numerical methods for interproblems, nonlinear root finding prolements convergence statements for the explain aspects for the practical exert and storage complexity. | plems and to explain their core in numerical methods, | ideas, | - | |
| Skills | implement, apply and compare num justify the convergence behaviour solution algorithm, select and execute a suitable solution. | of numerical methods with re | • | e problem and | |
| Personal Competence | | | | | |
| Social Competence | work together in heterogeneously c and background knowledge), expla practical aspects regarding the imple | ain theoretical foundations an | | | |
| | Students are capable | | | | |
| Autonomy | to assess whether the supporting individually or in a team, to assess their individual progess ar | · | | | |
| Workload in Hours | Independent Study Time 124, Study Time in | Lecture 56 | | | |
| Credit points | | | | | |
| Studienleistung | | | | | |
| Examination | Written exam | | | | |
| Examination duration and scale | 90 minutes | | | | |
| | General Engineering Science (German prog General Engineering Science (German p Biomechanics: Compulsory General Engineering Science (German p Materials in Engineering Sciences: Compul General Engineering Science (German prog General Engineering Science (German p Compulsory | program): Specialisation Mechanogram): Specialisation Mechanogram): Specialisation Biomedica | anical Engi anical Engi al Engineeri | ineering, Focus ineering, Focus ng: Compulsor | |



General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulsory Assignment for the Electrical Engineering: Core qualification: Elective Compulsory **Following Curricula** General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

Course L0417: Numerical Mathematics I Typ Lecture Hrs/wk **CP** 3 Workload in Hours Independent Study Time 62, Study Time in Lecture 28 Lecturer Prof. Sabine Le Borne, Dr. Patricio Farrell Language DE/EN Cycle WiSe 1. Error analysis: Number representation, error types, conditioning and stability 2. Interpolation: polynomial and spline interpolation 3. Numerical integration and differentiation: order, Newton-Cotes formula, error estimates, Gaussian quadrature, adaptive quadrature, difference formulas 4. Linear systems: LU and Cholesky factorization, matrix norms, conditioning Content 5. Linear least squares problems: normal equations, Gram.Schmidt and Householder orthogonalization, singular value decomposition, regularization 6. Eigenvalue problems: power iteration, inverse iteration, QR algorithm 7. Nonlinear systems of equations: Fixed point iteration, root-finding algorithms for real-valued functions, Newton and Quasi-Newton methods for systems • Stoer/Bulirsch: Numerische Mathematik 1, Springer • Dahmen, Reusken: Numerik für Ingenieure und Naturwissenschaftler, Springer Literature

Computational Science and Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Process Engineering: Specialisation Process Engineering: Elective Compulsory



| Course L0418: Numerical Mathematics I | | |
|---------------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Sabine Le Borne, Dr. Patricio Farrell | |
| Language | DE/EN | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | | | |
|--|--|---|---|---|---|--------------------------------|
| Title | | | Тур | Hrs/wk | СР | |
| Heat Transfer (L0458) Heat Transfer (L0459) | | | Lecture Recitation Section (large) | 3 2 | 4 2 | |
| Module Responsible | Dr. Andreas Moschallski | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous Knowledge | Technical Thermodynamics I, II | and Fluid Dynar | nics | | | |
| Educational Objectives | After taking part successfully, st | udents have rea | ched the following learning | results | | |
| Professional Competence | | | | | | |
| | The students are able to | | | | | |
| | - describe the different physical | mechanism of H | leat Transfer, | | | |
| Knowledge | - explain the technical terms, | | | | | |
| | - to analyse comlex heat transfe | er processes in a | critical way. | | | |
| | The students are able to | | | | | |
| | - understand the physics of Hea | at Transfer, | | | | |
| Skills | · · | | processes, | | | |
| | - solve excersises self-consister | nt and in small g | roups. | | | |
| Personal Competence | | | | | | |
| Social Competence | The students are able to discuss | s in small groups | s and develop an approach | | | |
| · | The students are able to deve critical way. A qualified exchang | | | nd analyse | the result | s in |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | | | |
| Credit points | J | | | | | |
| Studienleistung | None | | | | | |
| Examination | Written exam | | | | | |
| Examination duration and scale | 1 1 2 () min | | | | | |
| | General Engineering Science Biomechanics: Compulsory General Engineering Science Energy Systems: Compulsory General Engineering Science (General Engineering Science Theoretical Mechanical Engineering Science (Focus Energy Systems: Compu General Engineering Science (General Eng | (German program (German program (German program ering: Compulso German program Isory | ram): Specialisation Mech n): Specialisation Biomedica ram): Specialisation Mech ory n, 7 semester): Specialisation | anical Engi al Engineeri anical Engi on Mechanic | ineering, ing: Comp ineering, cal Engine | Focu oulso Focu eerin |
| | Focus Theoretical Mechanical E General Engineering Science (Compulsory | Engineering: Cor | mpulsory | | _ | |
| Assignment for the Following Curricula | General Engineering Science (I General Engineering Science | | | | | |
| | Biomechanics: Compulsory | (English progr | ram): Specialisation Mech | anical Engi | ineering | Foc |
| | General Engineering Science Energy Systems: Compulsory | (Eligiisii piogi | am). Specialisation Mech | amcar Engi | oomig, | |
| | Energy Systems: Compulsory General Engineering Science | | | | _ | |



Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Energy Systems: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,
Focus Theoretical Mechanical Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering:
Compulsory
Mechanical Engineering: Specialisation Energy Systems: Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

| Course L0458: Heat Tra | ourse L0458: Heat Transfer | | | |
|------------------------|--|--|--|--|
| Тур | Lecture | | | |
| Hrs/wk | 3 | | | |
| СР | 4 | | | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | | | |
| Lecturer | Dr. Andreas Moschallski | | | |
| Language | DE | | | |
| Cycle | WiSe | | | |
| Content | Dimensional analysis, heat conduction, convective heat transfer, Two-phase heat transfer (evaporation, condensation), thermal radiation, heat exchangers, measurement methods | | | |
| Literature | Herwig, H.; Moschallski, A.: Wärmeübertragung, 3. Auflage, Springer Vieweg Verlag, Wiesbaden, 2014 Herwig, H.: Wärmeübertragung von A-Z, Springer- Verlag, Berlin, Heidelberg, 2000 Baehr, H.D.; Stephan, K.: Wärme- und Stoffübertragung, 2. Auflage, Springer Verlag, Berlin, Heidelberg, 1996 | | | |

| Course L0459: Heat Transfer | | |
|-----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Dr. Andreas Moschallski | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | |
|---|--|--|--|---|
| Fitle Practical Course: Measurem Measurement Technology fo | nent and Control Systems (L1119) or Mechanical and Process Engineers (L1116) or Mechanical and Process Engineers (L1118) | Typ Practical Course Lecture Recitation Section (large) | Hrs/wk 2 2 1 | CP 2 3 1 |
| Module Responsible | | (1.3.) | | |
| Admission Requirements | None | | | |
| · · · · · · · · · · · · · · · · · · · | Basic knowledge of physics, chemistry and electrical engineering | | | |
| | After taking part successfully, students have r | eached the following learning | results | |
| Professional Competence | | | | |
| | Students are able to name the most im (Quantities and Units, Uncertainty, Calibra Systems). | | | |
| Knowledge | They can outline the most important mea maesured (Electrical Quantities, Temperature | = | | |
| | They can describe important methods of Chromatography) | chemical Analysis (Gas Se | ensors, Spe | ctroscopy, G |
| Skills | Students can select suitable measuring methods to given problems and can use referin measurement devices in practice. The students are able to orally explain issues in the subject area of measurement technology an solution approaches as well as place the issues into the right context and application area. | | | |
| Personal Competence Social Competence | Students can arrive at work results in groups and document them in a common report. | | | |
| Autonomy | Students are able to familiarize themselves with new measurement technologies. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in I | _ecture 70 | | |
| Credit points | 6 | | | |
| Studienleistung | Compulsory Bonus Form Yes None Subject theore practical work | Description etical and | | |
| Examination | Written exam | | | |
| Examination duration and scale | 105 minutes | | | |
| | General Engineering Science (German Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German progri General Engineering Science (German progri General Engineering Science (German Environmental Engineering: Compulsory General Engineering Science (German progri Compulsory General Engineering Science (German progri | program): Specialisation ram): Specialisation Biomedica ram): Specialisation Process E program, 7 semester): Specialisation ram, 7 semester): Specialisation | Mechanica al Engineering: ingineering: pecialisation on Mechanic | Engineerin ng: Compulso Compulsory Energy an |



General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

Assignment for the Energy and Environmental Engineering: Core qualification: Compulsory

Following Curricula General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

> General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory

> General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory

> General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

> General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



| se L1119: Practical | Practical Course | |
|---------------------|--|--|
| Hrs/wk | | |
| CP | | |
| | | |
| Lecturer | ndependent Study Time 32, Study Time in Lecture 28 | |
| | | |
| Language | | |
| Сусіе | WiSe/SoSe Experiment 1: Emission and immission measurement of gaseous pollutants: different technologic determine different gaseous pollutants in automotive exhaust are used. | |
| Content | Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dyna behaviour of e pump engine will be investigated. The starting will be simulated on a PC and compa with measurement. Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will | |
| | understood and applications with Michelson interferometer and optical fibers demonstrated. Experiment 4:Identification of the parameters of a control system and optimal control parameters | |
| Literature | Versuch 1: Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974 Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmi Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979 Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenhe Naturschutz und Umweltgestaltung Gebrauchs- und Bedienungsanweisungen VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 l. 2455 Bl.1 Versuch 2: | |
| | Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren Simulationsmethoden, speziell: Verwendung von Blockschaltbildern Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze Versuch 3: | |
| | Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Ver Heidelberg, 1984 Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech Ho Boston, 1988 Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Bos 1989 | |
| | Versuch 4: Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelunge | |



| Tvn | Lecture | |
|-------------------|--|--|
| Hrs/wk | | |
| СР | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Dr. Sven Krause | |
| Language | | |
| Cycle | | |
| | 1 Fundamentals 1.1 Quantities and Units | |
| | 1.2 Uncertainty | |
| | 1.3 Calibration | |
| | 1.4 Static and Dynamic Properties of Sensors and Systems | |
| | 2 Measurement of Electrical Quantities | |
| | 2.1 Current and Voltage | |
| | 2.2 Impedance | |
| | 2.3 Amplification | |
| | 2.4 Oscilloscope | |
| | 2.5 Analog-to-Digital Conversion | |
| 0 | 2.6 Data Transmission | |
| Content | 3 Measurement of Nonelectric Quantities | |
| | 3.1 Temperature | |
| | 3.2 Length, Displacement, Angle | |
| | 3.3 Strain, Force, Pressure | |
| | 3.4 Flow | |
| | 3.5 Time, Frequency | |
| | 4 Chemical Analysis | |
| | 4.1 Gas Sensors | |
| | 4.2 Spectroscopy | |
| | 4.3 Gas Chromatography | |
| | At the end of each lecture students present single measuring techniques and results orally in fron the class. | |
| | Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Spring 2006, ISBN: 978-3-540-34055-3. | |
| Literature | Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 9 3486217940. | |



| Course L1118: Measurement Technology for Mechanical and Process Engineers | | |
|---|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dr. Sven Krause | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | | |
|--|--|--|--------------------------------------|--------------|----------------|
| Title Title | | Т | ур | Hrs/wk | СР |
| ntroduction to Control Syste ntroduction to Control Syste | , , | | ecture decitation Section (small) | 2 | 4 2 |
| Module Responsible | Prof. Herbert Werner | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | Representation of sign | s and systems in time and fr | equency domain, Lapl | ace transfor | m |
| Educational Objectives | After taking part succe | fully, students have reached | I the following learning | results | |
| Professional Competence | | | | | |
| Knowledge | Students can represent dynamic system behavior in time and frequency domain, and can i particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties i terms of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequence response They can explain issues arising when controllers designed in continuous time domain are implemented digitally | | | | |
| Skills | Students can transform models of linear dynamic systems from time to frequency domain and vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus and frequency response techniques They can calculate discrete-time approximations of controllers designed in continuous-time and use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out these tasks | | | | |
| Personal Competence | | | | | |
| Social Competence | | mall groups to jointly solve | technical problems, a | and experim | entally valida |
| | experiment guides) an | formation from provided suse it when solving given prowledge in weekly on-line t | roblems. | | |
| Autonomy | | omougo m noom, on mo | | | g p. 0g. 000. |
| Workload in Hours | Independent Study Tir | 124, Study Time in Lecture | 56 | | |
| Credit points | | , Just j initial in Locidio | | | |
| Studienleistung | | | | | |
| | Written exam | | | | |
| Examination duration and scale | | | | | |



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

General Engineering Science (English program): Core qualification: Compulsory

Assignment for the General Englowing Curricula Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory



Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective

Compulsory

Process Engineering: Core qualification: Compulsory

| Course L0654: Introduct | ion to Control Systems | | |
|-------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | | | |
| СР | 4 | | |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 | | |
| | Prof. Herbert Werner | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Signals and systems Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle Root locus techniques Root locus design of PID controllers Frequency response techniques Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Time delay systems Root locus and frequency response of time delay systems Smith predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers Software tools Introduction to Mattab, Simulink, Control toolbox | | |
| Literature | Computer-based exercises throughout the course Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems' Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010 | | |



| Course L0655: Introduction to Control Systems | | |
|---|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Herbert Werner | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | |
|--|---|---------------------------------|----------------------|------------------|
| Title | | Тур | Hrs/wk | СР |
| ntroduction to Biochemistry | and Molecular Biology (L0386) | Lecture | 2 | 3 |
| Module Responsible | Prof. Hans-Jürgen Kreienkamp | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | None | | | |
| Educational Objectives | After taking part successfully, students | s have reached the following le | earning results | |
| Professional | | | | |
| Competence | The students can | | | |
| | The students can | | | |
| Knowledge | describe basic biomolecules; explain how genetic information explain the connection between | | | |
| | The students can | | | |
| Skills | recognize the importance of m describe selected molecular-d explain the relevance of these | iagnostic procedures; | | |
| Personal Competence | | | | |
| Social Competence | The students can participate in discus | sions in research and medicin | e on a technical lev | vel. |
| Autonomy | The students can develop understathemselves. | nding of topics from the cou | rse, using technic | al literature, l |
| Workload in Hours | Independent Study Time 62, Study Tir | ne in Lecture 28 | | |
| Credit points | 3 | | | |
| Studienleistung | None | | | |
| | Written exam | | | |
| Examination duration and scale | 60 minutes | | | |
| | General Engineering Science (Gerr Biomechanics: Compulsory | man program): Specialisation | Mechanical Engi | neering, Focu |
| | General Engineering Science (Germa General Engineering Science (Germa Compulsory | | | |
| | General Engineering Science (Germa Focus Biomechanics: Compulsory | | | al Engineerin |
| | Electrical Engineering: Specialisation General Engineering Science (Eng Biomechanics: Compulsory | | | neering, Foc |
| Assignment for the Following Curricula | General Engineering Science (Englis General Engineering Science (Englis Focus Biomechanics: Compulsory | | | |
| | General Engineering Science (Englis Compulsory | h program, 7 semester): Spec | ialisation Biomedic | al Engineerin |
| | Mechanical Engineering: Specialisati Biomedical Engineering: Specialis Compulsory | | | ration: Electiv |
| | Biomedical Engineering: Specialisa Compulsory | _ | _ | |
| | Biomedical Engineering: Specialisation Biomedical Engineering: Specialisation Technomathematics: Core qualification | on Implants and Endoprosthes | | |



Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

| Course L0386: Introduction to Biochemistry and Molecular Biology | | | |
|--|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Hans-Jürgen Kreienkamp | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | | | |
| | Müller-Esterl, Biochemie, Spektrum Verlag, 2010; 2. Auflage | | |
| | Löffler, Basiswissen Biochemie, 7. Auflage, Springer, 2008 | | |
| Literature | | | |
| | | | |
| | | | |
| , | | | |



| Module M1333: BIG | O I: Implants and Fracture Hea | ling | | |
|--------------------------------------|--|--|--|--|
| Courses | | | | |
| Title Implants and Fracture Heali | ng (L0376) | Typ Lecture | Hrs/wk 2 | CP 3 |
| Module Responsible | Prof. Michael Morlock | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | It is recommended to participate in "In Fracture Healing". | ntroduction into Anatomie" | before attending | "Implants and |
| Educational Objectives | After taking part successfully, students ha | ve reached the following le | arning results | |
| Professional Competence | | | | |
| Knowledge | The students can describe the differe existence. The students can name different treatm morphologies. The students can determine the forces | nents for the spine and ho | ollow bones under | given fracture |
| | under specific assumptions. | avang mam are naman a | you, amusi quasi s | |
| Personal Competence | | | | |
| Social Competence | | _ | | |
| Autonomy | The students can, in groups, solve basic | numerical modeling tasks it | or the calculation of | internal forces. |
| Workload in Hours | Independent Study Time 62, Study Time | in Lecture 28 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| | Written exam | | | |
| Examination duration and scale | 90 min | | | |
| _ | General Engineering Science (German Biomechanics: Compulsory General Engineering Science (German p General Engineering Science (German p Focus Biomechanics: Compulsory General Engineering Science (German p Compulsory General Engineering Science (German p General Engineering Science (English pr Focus Biomechanics: Compulsory General Engineering Science (English pr Focus Biomechanics: Compulsory General Engineering Science (English pr Compulsory Mechanical Engineering: Specialisation Biomedical Engineering: Specialisation Biomedical Engineering: Specialisation Biomedical Engineering: Specialisation Biomedical Engineering: Specialisation Reiomedical Engineering: Specialisation Rei | rogram): Specialisation Bio rogram, 7 semester): Special rogram, 7 semester): Special rogram): Specialisation Bior program): Specialisation Bior program): Specialisation rogram, 7 semester): Special rogram, 7 semester): | medical Engineering alisation Mechanical Engineering Mechanical Engineering Mechanical Engiralisation Mechanical Engiralisation Mechanical Engiralisation Biomedical Engiralisation Biomedical Engineerative Medical Elective Computation Theory: Elective Elec | g: Compulsory al Engineering g: Compulsory leering, Focus al Engineering al Engineering icine: Elective sory ve Compulsory |



| ourse L0376: Implants | and Fracture Healing | |
|-----------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | | |
| | Independent Study Time 62, Study Time in Lecture 28 | |
| | Prof. Michael Morlock | |
| Language Cycle | | |
| 5,0.0 | Topics to be covered include: | |
| | Introduction (history, definitions, background importance) | |
| | 2. Bone (anatomy, properties, biology, adaptations in femur, tibia, humerus, radius) | |
| | 3. Spine (anatomy, biomechanics, function, vertebral bodies, intervertebral disc, ligaments) | |
| | 3.1 The spine in its entirety | |
| | 3.2 Cervical spine | |
| | 3.3 Thoracic spine | |
| | 3.4 Lumbar spine | |
| | 3.5 Injuries and diseases | |
| | 4. Pelvis (anatomy, biomechanics, fracture treatment) | |
| Content | 5 Fracture Healing | |
| | 5.1 Basics and biology of fracture repair | |
| | 5.2 Clinical principals and terminology of fracture treatment | |
| | 5.3 Biomechanics of fracture treatment | |
| | 5.3.1 Screws | |
| | 5.3.2 Plates | |
| | 5.3.3 Nails | |
| | 5.3.4 External fixation devices | |
| | 5.3.5 Spine implants | |
| | 6.0 New Implants | |
| | Cochran V.B.: Orthopädische Biomechanik | |
| | | |
| | Mow V.C., Hayes W.C.: Basic Orthopaedic Biomechanics | |
| | White A.A., Panjabi M.M.: Clinical biomechanics of the spine | |
| Literature | | |
| | Schiebler T.H., Schmidt W.: Anatomie | |
| | Platzer: dtv-Atlas der Anatomie, Band 1 Bewegungsapparat | |
| | | |
| | | |



| Module M0829: Fo | undations of Management | | | |
|--|---|--|---|--|
| - | | | | |
| Courses Title | | Тур | Hrs/wk | СР |
| Management Tutorial (L088: Introduction to Management | | Recitation Section (large) Lecture | 2 3 | 3 3 |
| Module Responsible | Prof. Christoph Ihl | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Basic Knowledge of Mathematics and Busir | ess | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | After taking this module, students know the Management, from Planning and Organisa and Controlling. In particular they are able to explain the differences between E Management and to name important explain the most important aspects aspects of entreprneurial projects describe and explain basic busing supply chain management, organic | ction to Marketing and Innovation Economics and Management at definitions from the field of Mar of and goals in Management areas functions as production, p | on, and als and the su nagement nd name the | b-disciplines i most importar and sourcing |
| | management, innovation management explain the relevance of planning a multiple objectives and uncertainty Finance state basics from accounting and constitutions. Students are able to analyse business unit | and decision making in Busines y, and explain some basic m sting and selected controlling m s with respect to different criteri | ethods from ethods. a (organiza | n mathematic |
| Skills | strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to analyse Management goals and structure them appropriately analyse organisational and staff structures of companies apply methods for decision making under multiple objectives, under uncertainty and under risk analyse production and procurement systems and Business information systems analyse and apply basic methods of marketing select and apply basic methods from mathematical finance to predefined problems apply basic methods from accounting, costing and controlling to predefined problems | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a coherence. | | | |
| Autonomy | Students are able to work in a team and to organize the to to write a report on their project. | eam themselves | | |
| | Independent Study Time 110, Study Time in | Lecture 70 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| | Subject theoretical and practical work | | | |
| Examination duration | | | | |



and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

Assignment for the Following Curricula

Compulsory

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:



Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

| Course L0882: Managen | nent Tutorial |
|-----------------------|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Christoph Ihl, Katharina Roedelius, Tobias VIcek |
| Language | DE |
| Cycle | WiSe/SoSe |
| Content | In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools. If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on self-selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the business knowledge from the lecture should come to practical use. The group projects are guided by a mentor. |
| Literature | Relevante Literatur aus der korrespondierenden Vorlesung. |



| irse L0880: Introduct | ion to Management | | | | |
|-----------------------|---|--|--|--|--|
| Тур | Lecture | | | | |
| Hrs/wk | 3 | | | | |
| СР | 3 | | | | |
| Workload in Hours | ndependent Study Time 48, Study Time in Lecture 42 | | | | |
| Lecturer | Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrir Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona | | | | |
| Language | DE | | | | |
| Cycle | WiSe/SoSe | | | | |
| Content | Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects | | | | |
| Literature | Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgar 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006. | | | | |



| Module M0634: Int | roduction into Med | dical Technology | and Systems | | |
|---|---|---------------------------------------|--|-----------------------|-----------------|
| Courses | | | | | |
| Introduction into Medical Ted | chnology and Systems (L03- chnology and Systems (L03- chnology and Systems (L18 | 43) | Typ Lecture Project Seminar Recitation Section (large) | Hrs/wk 2 2 1 | CP 3 2 1 |
| | Prof. Alexander Schlaefe | er | | | |
| Admission Requirements | None | | | | |
| | principles of math (algebrainciples of stochastics principles of programmir | | | | |
| Educational Objectives | After taking part success | fully, students have reach | ned the following learning | results | |
| Professional Competence | | | | | |
| Knowledge | The students can explain principles of medical technology, including imaging systems, computer aided surgery, and medical information systems. They are able to give an overview of regulatory affairs and standards in medical technology. | | | | |
| Skills | The students are able to | evaluate systems and me | edical devices in the conte | ext of clinical | applications. |
| Personal Competence | ! ! | | | | |
| Social Competence | The students describe a problem in medical technology as a project, and define tasks that are solved in a joint effort. | | | | |
| Autonomy | The students can reflect their knowledge and document the results of their work. They can present the results in an appropriate manner. | | | | |
| Workload in Hours | Independent Study Time | 110, Study Time in Lectu | ire 70 | | |
| Credit points | 6 | | | | |
| Studienleistung | Yes 10 % | Form Presentation Written elaboration | Description | | |
| Examination | Written exam | | | | |
| Examination duration and scale | 90 minutes | | | | |
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory Electrical Engineering: Core qualification: Elective Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory | | | | |



| Course L0342: Introduct | ion into Medical Technology and Systems |
|-------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Alexander Schlaefer |
| Language | DE |
| Cycle | SoSe |
| Content | imaging systems computer aided surgery medical sensor systems medical information systems regulatory affairs standard in medical technology The students will work in groups to apply the methods introduced during the lecture using problem based learning. |
| Literature | Wird in der Veranstaltung bekannt gegeben. |

| Course L0343: Introduct | ourse L0343: Introduction into Medical Technology and Systems | | |
|-------------------------|---|--|--|
| Тур | Project Seminar | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Alexander Schlaefer | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Course L1876: Introduct | ion into Medical Technology and Systems |
|-------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Alexander Schlaefer |
| Language | DE |
| Cycle | SoSe |
| Content | imaging systems computer aided surgery medical sensor systems medical information systems regulatory affairs standard in medical technology The students will work in groups to apply the methods introduced during the lecture using problem based learning. |
| Literature | Wird in der Veranstaltung bekannt gegeben. |



| Module M1280: ME | ED II: Introduction to Physiology | | |
|-----------------------------------|--|---------------|--|
| Courses | | | |
| Title | Typ Hrs/wk | СР | |
| Introduction to Physiology (L | L0385) Lecture 2 | 3 | |
| Module Responsible | Dr. Roger Zimmermann | | |
| Admission Requirements | INone | | |
| Recommended Previous Knowledge | INONG | | |
| Educational Objectives | After taking part successfully, students have reached the following learning results | | |
| Professional Competence | | | |
| Knowledge | describe the basics of the energy metabolism: | neuro- and | |
| Skills | The students can describe the effects of basic bodily functions (sensory, transmission and of information, development of forces and vital functions) and relate them to similar technic | | |
| Personal Competence | <u> </u> | | |
| Social Competence | The students can conduct discussions in research and medicine on a technical level. The students can find solutions to problems in the field of physiology, both analytical and n | netrological. | |
| Autonomy | The students can derive answers to questions arising in the course and other physiologousing technical literature, by themselves. | ogical areas, | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Credit points | 3 | | |
| Studienleistung | | | |
| | Written exam | | |
| Examination duration and scale | 60 minutes | | |
| _ | General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Technomathematics: Core qualification: Elective Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory | | |



| Course L0385: Introduction to Physiology | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Dr. Roger Zimmermann | |
| Language | DE | |
| Cycle | SoSe | |
| Content | | |
| | Taschenatlas der Physiologie, Silbernagl Despopoulos, ISBN 978-3-135-67707-1, Thieme | |
| Literature | Repetitorium Physiologie, Speckmann, ISBN 978-3-437-42321-5, Elsevier | |



| Module M1332: BIG | O I: Experimental Methods i | n Biomechanics | | |
|--|---|----------------------------------|--|----------------|
| | , p | | | |
| Courses | | | | |
| Title Experimental Methods in Bio | omechanics (L0377) | Typ Lecture | Hrs/wk 2 | CP 3 |
| Module Responsible | Prof. Michael Morlock | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | It is recommended to participate in "Methoden". | Implantate und Frakturheilung" | before attending " | Experimentelle |
| Educational Objectives | After taking part successfully, student | s have reached the following lea | arning results | |
| Professional Competence | | - | | |
| Knowledge | The students can describe the different ways how bones heal, and the requirements for their existence. The students can name different treatments for the spine and hollow bones under given fracture morphologies. The students can describe different measurement techniques for forces and movements, and choose the adequate technique for a given task. | | | |
| Skills | The students can describe the biomechanics. | pasic handling of several ex | perimental techni | ques used ir |
| Personal Competence | | | | |
| Social Competence | The students can, in groups, solve ba | sic experimental tasks. | | |
| Autonomy | The students can, in groups, solve ba | sic experimental tasks. | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | | |
| Credit points | <u> </u> | | | |
| Studienleistung | | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 90 min | | | |
| _ | General Engineering Science (German program): Specialisation Mechanical Engineering, For Biomechanics: Compulsory General Engineering Science (German program): Specialisation Biomedical Engineering: Compuls General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, For Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compuls Biomedical Engineering: Specialisation Management and Business Administration: Electompulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory | | ng: Compulsory al Engineering g: Compulsory neering, Focus al Engineering al Engineering icine: Elective lsory ve Compulsory | |



| Course L0377: Experimental Methods in Biomechanics | |
|--|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Michael Morlock |
| Language | DE |
| Cycle | SoSe |
| Content | |
| Literature | Wird in der Veranstaltung bekannt gegeben |



Specialization Naval Architecture

The Bachelor Course "Naval Architecture" prepares by the elective modules for scientific tasks in naval architecture, ocean engineering and related mechanical engineering disciplines. Thus, the occupational orientation can either related to the design of ships or offshore systems, or to more dedicated areas, such as hydrodynamics or strength of structures.

| Courses | | | | |
|--|--|---|------------------|---------------------|
| Title Introduction to Control Syste Introduction to Control Syste | | Typ Lecture Recitation Section (small) | Hrs/wk 2 2 | CP 4 2 |
| Module Responsible | Prof. Herbert Werner | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Representation of signals and syste | Representation of signals and systems in time and frequency domain, Laplace transform | | |
| Educational Objectives | After taking part successfully, stude | nts have reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Students can represent dynamic system behavior in time and frequency domain, and can particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties terms of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequence response They can explain issues arising when controllers designed in continuous time domain a implemented digitally | | | |
| Skills | Students can transform models of linear dynamic systems from time to frequency domain at vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus at frequency response techniques They can calculate discrete-time approximations of controllers designed in continuous-tin and use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out the tasks | | | |
| Personal Competence | | | | |
| Social Competence | Students can work in small groups their controller designs | s to jointly solve technical problems, a | nd experim | nentally valida |
| Autonomy | Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress | | | |



| Worklead in Hours | Independent Study Time 124, Study Time in Lecture 56 |
|--------------------------------|---|
| Studienleistung | None |
| Examination | Written exam |
| Examination duration and scale | 120 min |
| and scale | General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architectu Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy a Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineerin Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Mechatronics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Biomechanics: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Aitcraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Aterials in Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineerin Focus Energy Systems: Compulsory Bioprocess Engineering: Core qualification: Compulsory |
| Assignment for the | Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science Compulsory |
| r ollowing our ricula | General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineerin Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architectu Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineerin Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering Science (English program, 7 semester): Specialisation Electrical Engineering |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineerin Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environment Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineerin Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineerin |
| | Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineerin Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineerin Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineerin Focus Materials in Engineering Sciences: Compulsory |



General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,

Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory
Computational Science and Engineering: Core qualification: Compulsory
Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective

Compulsory

Process Engineering: Core qualification: Compulsory



| Typ | Lecture | | |
|------------|---|--|--|
| Hrs/wk | | | |
| СР | | | |
| | Independent Study Time 92, Study Time in Lecture 28 | | |
| | Prof. Herbert Werner | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Signals and systems Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle Root locus techniques Root locus design of PID controllers Frequency response techniques Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Time delay systems Root locus and frequency response of time delay systems Smith predictor Digital control Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers | | |
| Literature | Computer-based exercises throughout the course Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, N 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010 | | |



| Course L0655: Introduction to Control Systems | |
|---|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Herbert Werner |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | | |
|-----------------------------------|--|--|--|--|--|
| Title Computer Engineering (L032 | | | Typ Lecture | Hrs/wk | CP 4 |
| Computer Engineering (L032 | <u>, </u> | | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Heiko Falk | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | | | | | |
| Educational Objectives | After taking part success | fully, students have re | eached the following learning | g results | |
| Professional Competence | | | | | |
| Knowledge | from the assembly-level Introduction Combinational necombinational necombinational necombinational necombinational necombinational necombinational necombinational necombinational necombination neco | logic: Gates, Boole etworks Flip-flops, automata, undations etic: Integer addition, outer architecture: Fory hierarchies, SRAM from the perspective sees computer systems from cal composition of computers can be buildinguish between and my gates and circuits under the module, imputer system and unces that the executive language down to | e functionality of computing of gates. The module includes of gates. The students are able to just the software executed on the gates. This way, they will we on an entire system's product of gates. This way, they will we on an entire system's product of gates. This way, they will we on an entire system's product of gates. The student's product of gates. This way, they will we on an entire system's product of gates. | tions, hardy ad division a single-cyc passing data i.e., they ide nts can analy ew and simp betraction la adge the inte it. In partic hardware-ce be enabled | g topics: vare synthesis le architecture a, point-to-poin ntify the interna yze, how highly ile components yers of today's erdependencies ular, they sha ntric abstraction to evaluate the |
| Personal Competence | | | | | |
| Social Competence | Students are able to solv | ve similar problems a | one or in a group and to pres | sent the resu | Its accordingly. |
| Autonomy | Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. | | | | |
| Workload in Hours | Independent Study Time | e 124, Study Time in L | ecture 56 | | |
| Credit points | 6 | | | | |
| | Compulsory Bonus | Form | Description | | |



| Examination duration and scale | 90 minutes, contents of course and labs |
|--------------------------------|---|
| | General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and |
| | Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory |
| | Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory |
| | General Engineering Science (English program): Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental |
| | Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Materials in Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory |



Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory

| Course L0321: Compute | er Engineering |
|-----------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Heiko Falk |
| Language | DE |
| Cycle | WiSe |
| Content | Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output |
| Literature | A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. |

| Course L0324: Computer Engineering | |
|------------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Heiko Falk |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M0829: Fo | undations of Management | | | |
|-----------------------------------|--|---------------------------------------|-------------|----------------|
| | and all on a management | | | |
| Courses | | _ | , . | |
| Title Management Tutorial (L088) | 2) | Typ Recitation Section (large) | Hrs/wk 2 | CP 3 |
| Introduction to Management | | Lecture | 3 | 3 |
| Module Responsible | Prof. Christoph Ihl | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | | ss | | |
| Educational Objectives | After taking part successfully, students have re | eached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Management, from Planning and Organisation to Marketing and Innovation, and also to Investment and Controlling. In particular they are able to explain the differences between Economics and Management and the sub-disciplines in Management and to name important definitions from the field of Management explain the most important aspects of and goals in Management and name the most important aspects of entreprneurial projects describe and explain basic business functions as production, procurement and sourcing, supply chain management, organization and human ressource management, information management, innovation management and marketing explain the relevance of planning and decision making in Business, esp. in situations under multiple objectives and uncertainty, and explain some basic methods from mathematical Finance state basics from accounting and costing and selected controlling methods. | | | |
| Skills | Students are able to analyse business units with respect to different criteria (organization, objectives strategies etc.) and to carry out an Entrepreneurship project in a team. In particular, they are able to • analyse Management goals and structure them appropriately • analyse organisational and staff structures of companies • apply methods for decision making under multiple objectives, under uncertainty and under risk • analyse production and procurement systems and Business information systems • analyse and apply basic methods of marketing • select and apply basic methods from mathematical finance to predefined problems • apply basic methods from accounting, costing and controlling to predefined problems | | | |
| Personal Competence | ! ! | | | |
| Social Competence | Students are able to work successfully in a team of students to apply their knowledge from the lecture to an entrepreneurship project and write a coheren report on the project to communicate appropriately and to cooperate respectfully with their fellow students. | | | |
| Autonomy | Students are able to work in a team and to organize the team themselves to write a report on their project. | | | |
| | Independent Study Time 110, Study Time in L | ecture 70 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| | Subject theoretical and practical work | | | |
| Examination duration | | | | |



and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

Assignment for the Following Curricula

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering:

Compulsory
General Engineering Science (English program, 7 semester): Specialisation Process Engineering:
Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:



Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

| Course L0882: Management Tutorial | | | |
|-----------------------------------|--|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Christoph Ihl, Katharina Roedelius, Tobias VIcek | | |
| Language | DE | | |
| Cycle | WiSe/SoSe | | |
| Content | In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools. If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on self-selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the business knowledge from the lecture should come to practical use. The group projects are guided by a mentor. | | |
| Literature | Relevante Literatur aus der korrespondierenden Vorlesung. | | |



| ourse L0880: Introduct | ion to Management |
|------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Prof. Christoph Ihl, Prof. Thorsten Blecker, Prof. Christian Lüthje, Prof. Christian Ringle, Prof. Kathrin Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona |
| Language | DE |
| Cycle | WiSe/SoSe |
| Content | Introduction to Business and Management, Business versus Economics, relevant areas in Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Supply Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opporunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects |
| Literature | Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttgart 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemeine Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006. |



| Module M0854: Ma | athematics IV | | | | |
|-----------------------------------|--|-----------------------------------|-------------|------------------|--|
| Courses | | | | | |
| Title | | Tun | Hrs/wk | СР | |
| | rtial Differential Equations) (L1043) | Typ Lecture | 115/WK 2 | 1 | |
| | rtial Differential Equations) (L1044) | Recitation Section (small) | 1 | 1 | |
| | tial Differential Equations) (L1045) | Recitation Section (large) | 1 | 1 | |
| Complex Functions (L1038) | | Lecture | 2 | 1 | |
| Complex Functions (L1041) | | Recitation Section (small) | 1 | 1 | |
| Complex Functions (L1042) | | Recitation Section (large) | 1 | 1 | |
| Module Responsible | Prof. Anusch Taraz | | | | |
| Admission Requirements | I None | | | | |
| Recommended Previous Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students have | e reached the following learning | results | | |
| Professional | | 3 9 | | | |
| Competence | | | | | |
| • | | anto in Mathematica IV. There are | oble to | Join them | |
| | Students can name the basic conce appropriate examples. | epts in Mathematics IV. They are | able to exp | olain them using | |
| | Students can discuss logical con | nections between these conce | nts They | are canable o | |
| Knowledge | | | pis. They | ате сарабіе с | |
| 3 | They know proof strategies and can | | | | |
| | | · | | | |
| | | | | | |
| | | | | | |
| Skills | Students can model problems in Mathematics IV with the help of the concepts studied in this course. Moreover, they are capable of solving them by applying established methods. Students are able to discover and verify further logical connections between the concepts studied in the course. For a given problem, the students can develop and execute a suitable approach, and are able to critically evaluate the results. | | | | |
| Personal Competence | | | | | |
| | | | | | |
| | Students are able to work together | er in teams. They are capable | to use ma | thematics as a | |
| | common language. | many apparate assessment to 0 | manala ifil | alu acese colt | |
| Social Competence | In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their | | | | |
| Cosiai Compotonio | partners. Moreover, they can design examples to check and deepen the understanding of their peers. | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | Students are capable of checking the students are capable. | heir understanding of complex c | oncepts on | their own. They | |
| | can specify open questions precise | = - | • | | |
| Autonomy | Students have developed sufficient | | - | | |
| Autonomy | oriented manner on hard problems. | | | _ | |
| | | | | | |
| | | | | | |
| Workload in Hours | I Independent Study Time 68, Study Time in | Lecture 112 | | | |
| Credit points | <u> </u> | | | | |
| Studienleistung | | | | | |
| | Written exam | | | | |
| | | | | | |
| Examination duration and scale | 16() min (Complex Functions) + 6() min (L)iffe | erential Equations 2) | | | |
| | | | | | |



General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus

General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory

Assignment for the **Following Curricula**

Mechatronics: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering, Focus

Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

Computational Science and Engineering: Specialisation Engineering Sciences: Elective Compulsory Computational Science and Engineering: Specialisation Computer Science: Elective Compulsory Computational Science and Engineering: Specialisation Mathematics & Engineering Science: Elective Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Specialisation Mechatronics: Compulsory

Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective Compulsory



| Course L1043: Differential Equations 2 (Partial Differential Equations) | | | |
|---|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Main features of the theory and numerical treatment of partial differential equations Examples of partial differential equations First order quasilinear differential equations Normal forms of second order differential equations Harmonic functions and maximum principle Maximum principle for the heat equation Wave equation Liouville's formula Special functions Difference methods Finite elements | | |
| Literature | http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html | | |

| Course L1044: Differential Equations 2 (Partial Differential Equations) | | | |
|---|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Course L1045: Differential Equations 2 (Partial Differential Equations) | | |
|---|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Course L1038: Complex Functions | | | |
|---------------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Main features of complex analysis Functions of one complex variable Complex differentiation Conformal mappings Complex integration Cauchy's integral theorem Cauchy's integral formula Taylor and Laurent series expansion Singularities and residuals Integral transformations: Fourier and Laplace transformation | | |
| Literature | http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html | | |

| Course L1041: Complex Functions | | |
|---------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L1042: Complex Functions | | |
|---------------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Module M0960: Systems) | Mechanics | IV (Kinetics | II, Oscillations, | Analytical | Mechanics, | Multibody |
|---------------------------|-----------|--------------|-------------------|------------|------------|-----------|
| Courses | | | | | | |

| Courses | | | |
|------------------------------------|---|--------|----|
| Title | Тур | Hrs/wk | СР |
| (L1137) | Oscillations, Analytical Mechanics, Multibody Systems) Lecture | 3 | 3 |
| (L1138) | Oscillations, Analytical Mechanics, Multibody Systems) Recitation Section (small) | 2 | 2 |
| Mechanics IV (Kinetics II, (L1139) | Oscillations, Analytical Mechanics, Multibody Systems) Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof. Robert Seifried | | |
| Admission Requirements | None | | |
| Recommended Previous Knowledge | Mathematics I-III and Mechanics I-III | | |

Professional Competence

The students can

Knowledge

- describe the axiomatic procedure used in mechanical contexts;
- explain important steps in model design;

Educational Objectives After taking part successfully, students have reached the following learning results

present technical knowledge.

The students can

Skills

- explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context of their own problems;
- apply basic methods to engineering problems;
- estimate the reach and boundaries of the methods and extend them to be applicable to wider problem sets.

Personal Competence

Social Competence

The students can work in groups and support each other to overcome difficulties.

Students are capable of determining their own strengths and weaknesses and to organize their time Autonomy and learning based on those.

Workload in Hours Independent Study Time 96, Study Time in Lecture 84

Credit points 6

| Ctudionloiotuna | Compulsory Bonus No 20 % | | Form | Description |
|-----------------|--------------------------|------|---------|----------------------------|
| Studienieistung | No | 20 % | Midterm | Wird nur im SoSe angeboten |
| Examination | Written exam | | | |
| | i | | | |

Examination duration and scale

120 min

Engineering Science (German program): Specialisation Mechanical Engineering: General Compulsory

General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory



| Assignment for the | General Engineering Science (English program): Specialisation Naval Architecture: Compulsory |
|---------------------|---|
| Following Curricula | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: |
| | Compulsory |
| | Mechanical Engineering: Core qualification: Compulsory |
| | Mechatronics: Core qualification: Compulsory |
| | Naval Architecture: Core qualification: Compulsory |
| | Technomathematics: Specialisation III. Engineering Science: Elective Compulsory |
| | Technomathematics: Core qualification: Elective Compulsory |
| | Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective |
| | Compulsory |

| Course L1137: Mechanic | cs IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) |
|------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Prof. Robert Seifried |
| Language | DE |
| Cycle | SoSe |
| Content | Simple impact problems Principles of analytical mechanics Elements of vibration theory Vibration of Multi-degree of freedom systems Multibody Systems Numerical methods for time integration Introduction to Matlab |
| Literature | K. Magnus, H.H. Müller-Slany: Grundlagen der Technischen Mechanik. 7. Auflage, Teubner (2009). D. Gross, W. Hauger, J. Schröder, W. Wall: Technische Mechanik 1-4. 11. Auflage, Springer (2011). W. Schiehlen, P. Eberhard: Technische Dynamik, Springer (2012). |

| Course L1138: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) | |
|---|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Robert Seifried |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Course L1139: Mechanics IV (Kinetics II, Oscillations, Analytical Mechanics, Multibody Systems) | |
|---|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Robert Seifried |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | |
|--|--|--|---|--|
| litle it le | ту | ур | Hrs/wk | СР |
| Fluid Mechanics (L0454) Fluid Mechanics (L0455) | | ecture ecitation Section (large) | 3 2 | 4 2 |
| Module Responsible | Prof. Thomas Rung | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Sound knowledge of engineering mathematics, engineering engineering engineering engineering engineering engineering engin | neering mechanics and | l thermodyn | amics. |
| Educational Objectives | After taking part successfully, students have reached | the following learning | results | |
| Professional Competence | | | | |
| Knowledge | Students will have the required sound knowledge to explain the general principles of fluid engineerin and physics of fluids. Students can scientifically outline the rationale of flow physics usin mathematical models and are familiar with methods for the performance analysis and the prediciton of fluid engineering devices. | | | physics using |
| Skills | Students are able to apply fluid-engineering principles and flow-physics models for the analysis of technical systems. The lecture enables the student to carry out all necessary theoretical calculation for the fluid dynamic design of engineering devices on a scientific level. | | | |
| Personal Competence | | | | |
| Social Competence | The students are able to discuss problems and jointly | y develop solution strat | egies. | |
| Autonomy | The students are able to develop solution strategies analyse results. | for complex problems | self-consist | ent and crticall |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture | 70 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 180 min | | | |
| Assignment for the Following Curricula | General Engineering Science (German progration Compulsory General Engineering Science (German program): Spaceneral Engineering Science (German program): Spaceneral Engineering Science (German program, 7 scompulsory General Engineering Science (German program, 7 scompulsory General Engineering Science (German program, 7 scompulsory General Engineering Science (German program, Compulsory General Engineering Science (English program): Spaceneral Engineering Science (English program): Spaceneral Engineering Science (English program): Spaceneral Engineering Science (English program, 7 scompulsory General Engineering Science (English program, 7 scompulsory General Engineering Science (English program, 7 scompulsory | pecialisation Biomedical pecialisation Naval Archemester): Specialisation emester): Specialisation 7 semester): Specialisation Mechanical ecialisation Naval Archemester): Specialisation Naval Archemester): Specialisation | I Engineerin itecture: Con Mechanicon Biomedicon Nava Engineerin itecture: Con Mechanicon I Engineerin itecture: Con Mechanicon I | ng: Compulsor ompulsory al Engineering al Engineering al Architecture ng: Compulsory g: Compulsory mpulsory al Engineering |



Naval Architecture: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

| Course L0454: Fluid Med | chanics |
|-------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Thomas Rung |
| Language | DE |
| Cycle | SoSe |
| Content | Overview Physical/mathematical modelling Special phenomena Basic equations of fluid dynamics The turbulence problem One dimensional theory for inkompressibel flows One dimensional theory for kompressibel flows Flow over contours without friction Flow over contours with friction Flow through channels Simplified equations for three dimensional flow Special aspects of the numerical solution for complex flows |
| Literature | Herwig, H.: Strömungsmechanik, 2. Auflage, Springer- Verlag, Berlin, Heidelberg, 2006 Herwig, H.: Strömungsmechanik von A-Z, Vieweg Verlag, Wiesbaden, 2004 |

| Course L0455: Fluid Mechanics | |
|-------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Thomas Rung |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M0640: Sto | ochastics and Ship Dynamics | | |
|-------------------------------------|---|---------------|------------------|
| Courses | | | |
| Title | Tvo | Hrs/wk | СР |
| Ship Dynamics (L0352) | Typ Lecture | 2 | 3 |
| Ship Dynamics (L1620) | Recitation Section (small) | 1 | 1 |
| Statistics and Stochastic P (L0364) | rocesses in Naval Architecure and Ocean Engineering Lecture | 2 | 3 |
| Module Responsible | Prof. Moustafa Abdel-Maksoud | | |
| Admission Requirements | None | | |
| Recommended Previous Knowledge | l | | |
| Educational Objectives | After taking part successfully, students have reached the following learning | results | |
| Professional | | | |
| Competence | The students are able to sive an evention evention management. | how one | omo conlication |
| | The students are able to give an overview over various manoeuvres. T goals and they can describe the procedure of the manoeuvres. The students are able to give an overview over varius rudder types. The rudder design. | - | |
| Knowledge | - The students can name computation methods which are used to detern waves. | nine forces | and motions in |
| | The students can come up with the equations of motions which are used to can use and linearise them. The students are able to determine hydrodynamic coefficients and they meaning. | | |
| Skills | The students can explain how a rudder works and they can explain the physical effects which o | | |
| | - The students can mathematically describe waves. | | |
| | - The students can explain the mathematically description of harmoncial rcan determine them. | motions in | waves and the |
| Personal Competence | | | |
| , | - The students can arrive at work results in groups and document them. | | |
| Social Competence | | | |
| Autonomy | - The students can assess their own strengthes and weaknesses and the othis basis. | lefine furthe | er work steps or |
| Workload in Hours | Independent Study Time 140, Study Time in Lecture 70 | | |
| Credit points | 7 | | |
| Studienleistung | None | | |
| Examination | Written exam | | |
| Examination duration and scale | | | |
| | General Engineering Science (German program): Specialisation Naval Arch General Engineering Science (German program, 7 semester): Speciali Compulsory | | |



Assignment for the General Engineering Science (English program): Specialisation Naval Architecture: Compulsory Following Curricula General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

Naval Architecture: Core qualification: Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

| urse L0352: Ship Dyn | amics |
|----------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Moustafa Abdel-Maksoud |
| Language | DE |
| Cycle | SoSe |
| Content | Maneuverability of ships Equations of motion Hydrodynamic forces and moments Linear equations and their solutions Full-scale trials for evaluating the maneuvering performance Regulations for maneuverability Rudder Seakeeping Representation of harmonic processes Motions of a rigid ship in regular waves Flow forces on ship cross sections Strip method |
| | Consequences induced by ship motion in regular waves Behavior of ships in a stationary sea state Long-term distribution of seaway influences Abdel-Maksoud, M., Schiffsdynamik, Vorlesungsskript, Institut für Fluiddynamik un |
| Literature | Schiffstheorie, Technische Universität Hamburg-Harburg, 2014 Abdel-Maksoud, M., Ship Dynamics, Lecture notes, Institute for Fluid Dynamic and Shi Theory, Hamburg University of Technology, 2014 Bertram, V., Practical Ship Design Hydrodynamics, Butterworth-Heinemann, Linacre House Jordan Hill, Oxford, United Kingdom, 2000 Bhattacharyya, R., Dynamics of Marine Vehicles, John Wiley & Sons, Canada,1978 Brix, J. (ed.), Manoeuvring Technical Manual, Seehafen-Verlag, Hamburg, 1993 Claus, G., Lehmann, E., Östergaard, C). Offshore Structures, I+II, Springer-Verlag. Berli Heidelberg, Deutschland, 1992 Faltinsen, O. M., Sea Loads on Ships and Offshore Structures, Cambridge University Pres United Kingdom, 1990 Handbuch der Werften, Deutschland, 1986 Jensen, J. J., Load and Global Response of Ships, Elsevier Science, Oxford, United Kingdom 2001 Lewis, Edward V. (ed.), Principles of Naval Architecture - Motion in Waves and Controllabilit Society of Naval Architects and Marine Engineers, Jersey City, NJ, 1989 Lewandowski, E. M., The Dynamics of Marine Craft: Maneuvering and Seakeeping, Worl Scientific, USA, 2004 Lloyd, A., Ship Behaviour in Rough Weather, Gosport, Chichester, Sussex, United Kingdom 1998 |



| Course L1620: Ship Dynamics | |
|-----------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Moustafa Abdel-Maksoud |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| urse L0364: Statistics | s and Stochastic Processes in Naval Architecure and Ocean Engineering |
|------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Dr. Volker Müller |
| Language | DE |
| Cycle | WiSe |
| Content | descriptive statistics, parameter, criteria for outliers sample, sample space, probability, probability space Bayes method, conditional probability, law of total probability Discrete and continuous random variables Probability distributions mixed and joint random variables and their distribution Characteristics of random variables (expectation, variance, skewness, kurtosis,) (central) limit theorem Stochastic processes Statistical description of seaway, harmonic analysis of seaway narrow-banded Gaussian process, seaway and its characteristics sea- and wind spectra transformation of spectra, transfer function |
| Literature | V. Müller, Statistik und Stochastik in der Schiffs- und Meerestechnik, Vorlesungsskript, Institut für Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2014 W. Blendermann "Grundlagen der Wahrscheinlichkeitsrechnung", Vorlesungsskript, Arbeitsbereich Fluiddynamik und Schiffstheorie, Technische Universität Hamburg-Harburg, 2001 H. W. Coleman, W. G. Steele, Experimentation and Uncertainty Analysis for Engineers, 3 rd Edition John Wiley & Sons, Inc., New York, NY, 2009 ITTC Recommended Procedures and Guidelines, In: Quality Systems Manual, International Towing Tank Conference (ITTC), 2011 F.M. Dekking, C. Kraaikamp, H.P. Lopuhaä, L.E. Meester, A Modern Introduction To Probability and Statistics, Springer, 2005 Springer Handbook of Engineering Statistics, H. Pham (Hrsg.), Springer, 2006 A. Klenke, Wahrscheinlichkeitstheorie, Springer, 2013 |



| Courses | | | | |
|--|---|--|--|--------|
| Title | | Тур | Hrs/wk | СР |
| Computational Fluid Dynami Computational Fluid Dynami | | Lecture Recitation Section (large) | 2 2 | 3 3 |
| Module Responsible | · · · | | | |
| Admission Requirements | <u> </u> | | | |
| Recommended Previous Knowledge | Mathematical Methods for Enginee Fundamentals of Differential/integr | | s | |
| Educational Objectives | After taking part successfully, students hav | re reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The students are able to list the basic num | erics of partial differential equation | ons. | |
| Skills | The students are able develop appropria partial differential equations. They can coo | | | - |
| Personal Competence Social Competence | The students can arrive at work results in s | groups and document them. | | |
| Autonomy | The students can independently analyse a | approaches to solving specific pro | blems. | |
| Workload in Hours | I Independent Study Time 124, Study Time | in Lecture 56 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 2h | | | |
| Assignment for the Following Curricula | - IC-anaral Engineering Science (English program): Specialisation Mechanical Engineering Ed | | ompulsory ral Architecture cal Engineering ompulsory neering, Focu | |



| Course L0235: Computa | tional Fluid Dynamics I |
|-----------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Thomas Rung |
| Language | DE |
| Cycle | WiSe |
| Content | Fundamentals of computational modelling of thermofluid dynamic problems. Development of numerical algorithms. 1. Partial differential equations 2. Foundations of finite numerical approximations 3. Computation of potential flows 4. Introduction of finite-differences 5. Approximation of convective, diffusive and transient transport processes 6. Formulation of boundary conditions and initial conditions 7. Assembly and solution of algebraic equation systems 8. Facets of weighted -residual approaches 9. Finite volume methods 10. Basics of grid generation |
| Literature | Ferziger and Peric: Computational Methods for Fluid Dynamics, Springer |

| Course L0419: Computational Fluid Dynamics I | |
|--|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Thomas Rung |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | |
|-----------------------------------|---|--------------------------------|----------------|-----------------|
| Title | | Тур | Hrs/wk | СР |
| Fundamentals of Ship Struct | tural Design (L0411) | Lecture | 2 | 2 |
| Fundamentals of Ship Struct | | Recitation Section (small) | | 2 |
| Fundamentals of Ship Struct | | Lecture | 2 | 2 |
| Fundamentals of Ship Struct | tural Analysis (L0414) | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Sören Ehlers | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Mechanics I - III Fundamentals of Materials Science I - III Welding Technology I Fundamentals of Mechanical Design I - III | | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | g results | |
| Professional | | | | |
| Competence | Students can reproduce the basic contents explain the theory and methods for the structures. | | • | - |
| Knowledge | Furthermore, they can reproduce the basis of joining and principles of structural design of | | | nished produc |
| | Students are capable of applying the metho stresses in the above mentioned structure structures. | | | |
| Skills | Furthermore, they are capable to apply the select suitable materials, semi-finished prod | | g the ship str | ucture; they ca |
| Personal Competence | | | | |
| Social Competence | The students are able to communicate shipbuilding and component supply industry | | ssional envi | ronment in th |
| | The students are capable to independently i for analysis of beam-like structures; they are | | | |
| Autonomy | Furthermore, they are capable to assess of structures for various requirements and bound | | ructures and | to design sh |
| Workload in Hours | Independent Study Time 156, Study Time in | Lecture 84 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| | Written exam | | | |
| Examination duration and scale | 3 hours | | | |
| Assignment for the | General Engineering Science (German prog General Engineering Science (German prog Compulsory General Engineering Science (English prog | rogram, 7 semester): Specia | alisation Nav | val Architectur |



Following Curricula General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory
Naval Architecture: Core qualification: Compulsory

| ourse L0411: Fundamentals of Ship Structural Design | |
|---|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Sören Ehlers |
| Language | DE |
| Cycle | WiSe |
| Content | Chapters: 1. Introduction 3. Class societies and their tasks 4. Materials for steel shipbuilding 5. Welding and Cutting 6. Semi-finished products in steel shipbuilding 7. Determining the scantlings for local loads 8. Longitudinal strength of the hull girder 9. Determining the scantlings of longitudinal structural members 10. Determining the scantlings of bottom and side structures 11. Decks and Hatch Openings 12. Effective breadth 13. Iterative determination of scantlings (POSEIDON) |
| Literature | Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht |

| Course L0413: Fundamentals of Ship Structural Design | |
|--|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Sören Ehlers |
| Language | DE |
| Cycle | WiSe |
| Content | Chapters: 1. Introduction 3. Class societies and their tasks 4. Materials for steel shipbuilding 5. Welding and Cutting 6. Semi-finished products in steel shipbuilding 7. Determining the scantlings for local loads 8. Longitudinal strength of the hull girder 9. Determining the scantlings of longitudinal structural members 10. Determining the scantlings of bottom and side structures 11. Decks and Hatch Openings 12. Effective breadth 13. Iterative determination of scantlings (POSEIDON) |
| Literature | Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht |



| Course L0410: Fundamentals of Ship Structural Analysis | |
|--|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Sören Ehlers |
| Language | DE |
| Cycle | WiSe |
| Content | Contents: 1. Introduction 2. Finite element method (f.e. method) by the example of trussworks 3. Force methods for frameworks 4. F.e. method for frameworks 5. Shear and torsion in thin-walled beams 6. Beams subjected to longitudinal forces |
| Literature | Vorlesungsskript mit weiteren Literaturangaben; div. Bücher über die Methode der finiten Elemente |

| Course L0414: Fundamentals of Ship Structural Analysis | |
|--|--|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Sören Ehlers |
| Language | DE |
| Cycle | WiSe |
| Content | Contents: 1. Introduction 2. Finite element method (f.e. method) by the example of trussworks 3. Force methods for frameworks 4. F.e. method for frameworks 5. Shear and torsion in thin-walled beams 6. Beams subjected to longitudinal forces |
| Literature | Vorlesungsskript mit weiteren Literaturangaben; div. Bücher über die Methode der finiten Elemente |



| Module M0664: Str | ructural Design and Construct | ion of Ships | | |
|--|---|--|----------------------------|-------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Ship Structural Design (L041 | 12) | Lecture | 2 | 3 |
| Ship Structural Design (L041 | | Recitation Section (small) | 2 | 3 |
| Welding Technology (L1123) |) | Lecture | 3 | 3 |
| Module Responsible | Prof. Sören Ehlers | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Mechanics I - III Fundamentals of Materials Science I - III Welding Technology I Fundamentals of Mechanical Design I - II | I | | |
| Educational Objectives | After taking part successfully, students ha | ve reached the following learning | results | |
| Professional Competence | | | | |
| | Students can reproduce design and sizing as well as fabrication of the different areas of ship structures and of different ship types (incl. detail design); they can describe calculation models fo complex structures. | | | |
| Skills | Students are capable to specify the requi design criteria for the components, to si structure | | | |
| Personal Competence Social Competence | Students are capable to present their strigroup. | uctural design and discuss their d | ecisions co | nstructively in a |
| · | Students are capable to design indepen ship types and to define appropriate fabri | | the ship h | ull and differen |
| Autonomy | | | | |
| Workload in Hours | Independent Study Time 172, Study Time | in Lecture 98 | | |
| Credit points | 9 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 3 hours | | | |
| Assignment for the Following Curricula | General Engineering Science (German p General Engineering Science (German Compulsory General Engineering Science (English pr General Engineering Science (English Compulsory Naval Architecture: Core qualification: Co | program, 7 semester): Speciali rogram): Specialisation Naval Arch program, 7 semester): Speciali | sation Nav itecture: Co | al Architecture |



| Course L0412: Ship Structural Design | |
|--------------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Sören Ehlers |
| Language | DE |
| Cycle | SoSe |
| Content | Chapters: 1. Bulkheads and tanks 2. Structural design of forebodies 3. Structures in engine rooms 4. Aft bodies and rudders 5. Detail structural design 6. Outfitting 7. Bulk carriers 8. Tankers 9. Container ships 10. Production-kind steel structural design 11. Buckling and ultimate strength 12. Safety factors and reliability of structures |
| Literature | Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht |

| Course L0415: Ship Structural Design | |
|--------------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Sören Ehlers |
| Language | DE |
| Cycle | SoSe |
| Content | Chapters: 1. Bulkheads and tanks 2. Structural design of forebodies 3. Structures in engine rooms 4. Aft bodies and rudders 5. Detail structural design 6. Outfitting 7. Bulk carriers 8. Tankers 9. Container ships 10. Production-kind steel structural design 11. Buckling and ultimate strength 12. Safety factors and reliability of structures |
| Literature | Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht |



| Course L1123: Welding | Technology |
|-----------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Prof. Claus Emmelmann, Prof. Karl-Ulrich Kainer |
| Language | DE |
| Cycle | WiSe |
| | - phase transitions, phase diagrams and thermal activated processes |
| | - fundamentals of steels, heat treatment applications for steels and time temperature transformation diagrams |
| | - properties of weldable carbon and fine grained steels |
| | - properties of weldable low- and high-alloy steels, corrosion resistant steels and high-strength steels |
| | - structure and properties of non-ferrite metals (aluminum, titanium) |
| | - NDT/DT Methods for materials and welds |
| | - gas fusion welding, fundamentals of electric arc welding technologies |
| Content | - structure and influence parameters for the welded joint |
| | - submerged arc welding/tungsten inert gas welding/inert gas metal arc welding (MIG)/active gas metal arc welding (MAG)/Plasma Welding |
| | - resistance welding/ polymer welding/ hybrid-welding |
| | - deposition welding |
| | - electron beam welding/ laser beam welding |
| | - weld joint designs and declarations |
| | - computation methods for weld joint dimensioning |
| | |
| | Schulze, G.: Die Metallurgie des Schweißens, 4. Aufl., Berlin 2010 Strassburg, F.W. und Wehner H.: Schweißen nichtrostender Stähle, 4. Aufl. Düsseldorf, 2009 Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 1: Schweiß- und Schneidtechnologien, 3. Aufl., Berlin 2006. |
| Literature | Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 2: Verhalten der Werkstoffe beim Schweißen, 3. Aufl., Berlin 2005. |
| | Dilthey, U.: Schweißtechnische Fertigungsverfahren, Bd. 3: Gestaltung und Festigkeit von Schweißkonstruktionen, 2. Aufl., Berlin 2002. |
| | |



| Module M1109: Re | esistance and Propulsion | | | |
|---|---|--|------------------|---------------------|
| Courses | | | | |
| Title Resistance and Propulsion Resistance and Propulsion | | Typ Lecture Recitation Section (large) | Hrs/wk 2 2 | CP 3 3 |
| Module Responsible | Prof. Stefan Krüger | | | |
| Admission Requirements | | | | |
| Recommended Previous Knowledge | MechanicsFluid Dynamics for Naval ArchitectsHydrostratics | | | |
| Educational Objectives | After taking part successfully, students have reach | ned the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The hydrodynamic basics that are relevant for resistance and propulsion of ships are discussed. The different resistance phenomena and their practical applications to hullform design as well as numerical and empirical prediction methods are subject of the course. Furthermore, environmental additional resistances are dealt with. The course includes model test techniques and their application to full scale ships. This hold also for propulsion and hullefficiency elements, mainly thrust deduction and wake. Main Focus is how hull forms can be optimized for minimum and sustainable fuel consumption. The following topics are dealt with: - Stillwater/added resistance, Wave resistance, Minimization of wave resistance, numerical prediction methods, friction laws, laminar/turbulent flow separation, Hull form design for redcude flow separation, Appendage Design and resistance, Froude's resistance law,form factor method, thrust deduction, wake, model scaling laws, resistance tests, free running propeller tests and propeller basics, propulsion tests, full scale speed power predictions, additional resistances (wind, steering, current, sea state), EEDI, speed trials, contractual matters concerning speed/power, bunker claims | | | |
| Skills | The student shall learn to design competitive hull forms with respect to fuel consumption by applying numreical techniques and to evaluate these hulls by several progosis methods. Furtermore, the course will enable the student to clearl determine and minimize the required power including environmental influences. | | | |
| Personal Competence | | | | |
| Social Competence | suvervision team. | | • | _ |
| Autonomy | The student learns to prepare technical matters suvervision team. | in such a way that he ca | n compte w | ith his building |
| Workload in Hours | Independent Study Time 124, Study Time in Lectu | ıre 56 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 180 min | | | |
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory Naval Architecture: Core qualification: Compulsory | | | |



| Course L1265: Resistance and Propulsion | |
|---|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Stefan Krüger |
| Language | DE |
| Cycle | WiSe |
| Content | |
| Literature | |

| Course L1266: Resistance and Propulsion | |
|---|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Stefan Krüger |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Module M1118: Hy | drostatics and Body Plan | | | |
|-----------------------------------|--|----------------------------|--------------|---------------------|
| Courses | | | | |
| Title | 7 | Гур | Hrs/wk | СР |
| Hydrostatics (L1260) | L | _ecture | 2 | 3 |
| Hydrostatics (L1261) | F | Recitation Section (large) | 2 | 1 |
| Body Plan (L1452) | F | Project Seminar | 2 | 2 |
| Module Responsible | Prof. Stefan Krüger | | | |
| Admission Requirements | None | | | |
| | Good knowledge in Mathemathics I-III and Mechani | cs I-III. | | |
| Recommended Previous Knowledge | It is recommended that the students are familiar wit GA- Plan, Tank Plan etc. | h typical design relevar | nt drawings, | e.g. Body Plan |
| Educational Objectives | After taking part successfully, students have reached the following learning results | | | |
| Professional | | | | |
| Competence | | | | |
| Knowledge | The lecture enables the student to carry out all necessions of scientific level. The lecture is basic requirement for and safety of ships. | | | |
| Skills | The student is able to carry out hydrostatic calculated He is able to design hull forms that are safe against | | ship has su | ufficient stability |
| Personal Competence | | | | |
| Social Competence | The student gets access to hydrostatical problems. | | | |
| Autonomy | | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture | 84 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 180 min | | | |
| | General Engineering Science (German program): S General Engineering Science (German program, | | | |

| Course L1260: Hydrostatics | | |
|----------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Stefan Krüger | |
| Language | DE | |
| Cycle | SoSe | |
| | 1. Numerical Integration, Diffrentation, Interpolation | |
| | - Trapezoidal Rule, Simpson, Tschebyscheff, graphical Integration Methods | |
| | - Determination of Areas, 1st and 2nd order Moments | |

Naval Architecture: Core qualification: Compulsory

General Engineering Science (English program): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:

Compulsory

Assignment for the

Following Curricula



- Numerical Diffrentation, Spline Interpolation
- 2. Buyoancy
 - Principle of Archimedes
- Equlibrium Floating Condition
- Equlibrium Computations
- Hydrostatic Tables and Sounding Tables
- Trim Tables
- 3. Stability at large heeling angles
 - Stability Equation
 - Cross Curves of Stability and Righting Levers
- Numerical and Graphical Determination of Cross Curves
- Heeling Moments of Free Surfaces, Water on Deck, Water Ingress
- Heeling Moments of Different Type
- Balance of Heeling and Righting Moments acc. to BV 1030
- Intact Stability Code (General Critaria)
- 4. Linearization of Stability Problems
- Linearization of Restoring Forces and Moments
- Correlation between Metacentric Height and Righting Lever at small heeling angles
- Computation of Path of Metacentric Height for Modern Hull Forms
- Correlation between Righting Lever and Path of Metacentric Height
- Hydrostatic Stiffness Matrix
- Definition of MCT
- Computation of Equilibrum Floating Conditions from Hydrostatic Tables
- Effect of Free Surfaces on Initial GM
- Roll Motions at Small Roll Angles
- 6. Stability in Waves
 - Roll Motions at Large Amplitudes
 - Pure Loss of Stability on the Wave Crest
 - Principle of Parametric Excitation
- Principle of Direct Wave Moments

Content

- Grim's Equivalent Wave Concept
- 6 Longitudinal Strength
- Longitudinal Mass Distribution, Shear Forces, Bending Moments
- Longitudinal Strength in Stability Booklet
- 7. Deadweight Survey and Inclining Experiment
 - Deplacement Computations from Draft mark Readings
 - Weights to go on /come from board
 - Inclining Experiment with Heeling Moments from Weights and Heeling Tanks



- Determination of COG from Metacentric height and from Cross Curves
- Roll Decay Test
- 8. Launching and Docking
 - Launching Plan, Arrangement of Launching Blocks
 - Rigid Body Launching: Tilting, Dumping, Equation of Techel
 - Computation of Launching Event
 - Bottom Pressure and Longitudinal Strength
 - Linear- Elastic Effects
 - Transversal Stability on Slipway and in Dock
- 9. Grounding
- Loss of Buoynacy when Grounded
- Pointwise Grounding
- Ship Grounds on Keel
- 10. Introduction into Damage Stability Problems
 - Added Mass Method
 - Loss of Buoyant Volume Method
 - Simple Equilibrium Computations
 - Intermediate Stages of Flooding (Addes Mass Method), Cross- and Downflooding
 - Water Ingress Through Openings
- 11. Special Problems (optional and agreed upon)
 - e.g. Heavy Lift Operations
 - e.g. Jacking of Jackup Vessels
 - e.g. Sinking After Water Ingress

1. Herner/Rusch: Die Theorie des Schiffes Fachbuchverlag Leipzig

2. Henschke

Schiffstechnisches Handbuch, Band 1 VEB Technik Verlag Berlin

Literature

3. Das Skript zur Vorlesung, Anwendungsbeispiele und Klausuren sind auf unserer Homepage abrufbar.



| Course L1261: Hydrostatics | |
|----------------------------|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Prof. Stefan Krüger |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L1452: Body Pla | in . |
|------------------------|--|
| Тур | Project Seminar |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Stefan Krüger |
| Language | DE |
| Cycle | WiSe |
| Content | As preparation for the lecture "Hydrostatics", the students must develop a body plan of a modern twin screw vessel (cruise liner, RoPAx- feryy, RoRo) and perform elementary volumetric computations. The body plan is to be developed from a given GA or can be designed freely. All computations shall be based on graphical integration methods. The body plan consists of: - Grid - approx. 20 sections, 5 Waterlines, 5 Buttocks - Computation Volume and centre of buoyancy for several drafts - Computation of Righting Lever curve for a given displacement based on and graphical integration for several heeling angles. |
| Literature | 1. Herner/Rusch: Die Theorie des Schiffes Fachbuchverlag Leipzig 2. Henschke Schiffstechnisches Handbuch, Band 1 VEB Technik Verlag Berlin 3. Das Skript zur Vorlesung, Anwendungsbeispiele und Klausuren sind auf unserer Homepage abrufbar. |



| Module M0933: Fu | indamentals of Materials Science | | | |
|-----------------------------------|---|---|--|---|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Fundamentals of Materials S | Science I (L1085) | Lecture | 2 | 2 |
| | Science II (Advanced Ceramic Materials, Polymers a | | 2 | 2 |
| Composites) (L0506) | | | _ | |
| Physical and Chemical Basi | ics of Materials Science (L1095) | Lecture | 2 | 2 |
| Module Responsible | Prof. Jörg Weißmüller | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | | natics | | |
| Educational Objectives | After taking part successfully, students have read | ched the following learning | results | |
| Professional | <u> </u> | | | |
| Competence | | | | |
| Knowledge | The students have acquired a fundamental knowledge on metals, ceramics and polymers and can describe this knowledge comprehensively. Fundamental knowledge here means specifically the issues of atomic structure, microstructure, phase diagrams, phase transformations, corrosion and mechanical properties. The students know about the key aspects of characterization methods for materials and can identify relevant approaches for characterizing specific properties. They are able to trace materials phenomena back to the underlying physical and chemical laws of nature. | | | |
| Skills | The students are able to trace materials phenolaws of nature. Materials phenomena here refe and stiffness, chemical properties such as corrosolidification, precipitation, or melting. The st conditions and the materials microstructure, and the material's behavior. | rs to mechanical properties sion resistance, and to pha udents can explain the re | s such as str ase transforn lation betwe | ength, ductility nations such a een processin |
| Personal Competence | | | | |
| Social Competence | ! ! | | | |
| Autonomy | - | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lectu | ire 84 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | I 180 min | | | |
| | General Engineering Science (German pro | ogram): Specialisation E | Energy and | Enviromenta |
| | Engineering: Compulsory General Engineering Science (German p | rogram): Specialisation | Mechanical | Engineering |
| | Compulsory General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program |): Specialisation Biomedica): Specialisation Naval Arc | al Engineerii hitecture: Co | ng: Compulsor ompulsory |
| | Compulsory General Engineering Science (German program | | | |
| | Compulsory General Engineering Science (German progr Compulsory | am, 7 semester): Special | isation Nav | al Architecture |
| | General Engineering Science (German pr | ogram, 7 semester): Sp | oecialisation | Energy an |



| | Enviromental Engineering: Compulsory |
|---------------------|--|
| | Energy and Environmental Engineering: Core qualification: Compulsory |
| | General Engineering Science (English program): Specialisation Energy and Enviromental |
| Following Curricula | Engineering: Compulsory |
| _ | General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory |
| | General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory |
| | General Engineering Science (English program): Specialisation Naval Architecture: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: |
| | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental |
| | Engineering: Compulsory |
| | Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory |
| | Mechanical Engineering: Core qualification: Compulsory |
| | Mechatronics: Core qualification: Compulsory |
| | Naval Architecture: Core qualification: Compulsory |
| | Technomathematics: Specialisation III. Engineering Science: Elective Compulsory |

| Course L1085: Fundamentals of Materials Science I | | |
|---|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Jörg Weißmüller | |
| Language | DE | |
| Cycle | WiSe | |
| Content | | |
| Literature | Vorlesungsskript W.D. Callister: Materials Science and Engineering - An Introduction. 5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7 | |

| Course L0506: Fundame | entals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) |
|-----------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Bodo Fiedler, Prof. Gerold Schneider |
| Language | DE |
| Cycle | SoSe |
| Content | Chemische Bindungen und Aufbau von Festkörpern; Kristallaufbau; Werkstoffprüfung; Schweißbarkeit; Herstellung von Keramiken; Aufbau und Eigenschaften der Keramik; Herstellung, Aufbau und Eigenschaften von Gläsern; Polymerwerkstoffe, Makromolekularer Aufbau; Struktur und Eigenschaften der Polymere; Polymerverarbeitung; Verbundwerkstoffe |
| Literature | Vorlesungsskript W.D. Callister: Materials Science and Engineering -An Introduction-5th ed., John Wiley & Sons, Inc., New York, 2000, ISBN 0-471-32013-7 |



| Course L1095: Physical | and Chemical Basics of Materials Science | |
|------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Stefan Müller | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Motivation: "Atoms in Mechanical Engineering?" Basics: Force and Energy The electromagnetic Interaction "Detour": Mathematics (complex e-funktion etc.) The atom: Bohr's model of the atom Chemical bounds The multi part problem: Solutions and strategies Descriptions of using statistical thermodynamics Elastic theory of atoms Consequences of atomar properties on makroskopic Properties: Discussion of examples (metals, semiconductors, hybrid systems) | |
| Literature | Für den Elektromagnetismus: Bergmann-Schäfer: "Lehrbuch der Experimentalphysik", Band 2: "Elektromagnetismus", de Gruyter Für die Atomphysik: Haken, Wolf: "Atom- und Quantenphysik", Springer Für die Materialphysik und Elastizität: Hornbogen, Warlimont: "Metallkunde", Springer | |



| Module M1110: Sh | nip Design | | | | |
|-----------------------------------|---|----------------------------|------------|---|--|
| Courses | | | | | |
| Title | | Тур | Hrs/wk | СР | |
| Ship Design (L1262) | | Lecture | 2 | 3 | |
| Ship Design (L1264) | | Recitation Section (large) | 2 | 3 | |
| Module Responsible | | | | | |
| Admission Requirements | INono | | | | |
| Recommended Previous Knowledge | , | | | | |
| Educational Objectives | After taking part successfully, students have reached the following learning results | | | | |
| Professional Competence | | | | | |
| Knowledge | Competitive Elements of Ship Designs are thoroughly discussed. Typical bulding contrelated technical risk are introduced. The most important main parameters of a ship are int their influence on the competitiveness of a design. The lecture focusses on the influence main parameters on the total performance of a ship design and the consecutive process this lecture, the design changes are dealt with by simple models or formulae. The studen learn to model complex systems properly so that the relavent technical conclusions can be the lecture continues with an introduction into the different phases of design project, for design phase to a building contract. Further, methods are introduced to generate bulding relevant information at different levens of granularity during the different design stages. following topics are adressed: **Knowledge** - Structure of a building specification - Determination of Light Ship Weight and Deadweight Components - Design of main section and hull form - Design of aftbody lines and manoevering devices - Design of main propulsion plant - Design of subdivision - Determination of limiting GMrequ- Curves - Scantlings of most improtant structural members - Longitudinal strength - Outfitting Components - Relevant rules and regulations | | | ce of alternatedess elements. In ent shall further be drawn. If from the initiating specficationes. In detail, the | |
| Skills | The student is made familiar with the basic design principles of seagoing mearchant ships. The goal the lecture is that the student shall be able to carry out a concept design based on a vessel comparison fulfilling typical contract requirements within the Marine Environment. The lecture deal with the basic design methods to determine the fundamantal technical characteristics of a ship design with respect to fulfillment procedures of the contract values. Based on the lecture "Principles of Sh Design" the relevant methods to determine and judge uopn the performance of a ship design a treated. | | | | |
| Personal Competence | | | | | |
| Social Competence | The students learns to prepare technical matte customer against his competitors. | rs in such a way the he | can persua | de his potantia | |
| Autonomy | The students learns to prepare technical matters in such a way the he can persuade his potantial customer against his competitors. | | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lect | ure 56 | | | |
| Credit points | 6 | | | | |
| Studienleistung | None | | | | |
| Examination | Written exam | | | | |



| Examination duration and scale | 180 min |
|-----------------------------------|--|
| Accidnment for the | reportal Engineering Science (English program), Specialisation Mayar Architecture, Compilisory |

| Course L1262: Ship Design | |
|---------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Stefan Krüger |
| Language | DE |
| Cycle | SoSe |
| Content | |
| Literature | |

| Course L1264: Ship Design | |
|---------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Stefan Krüger |
| Language | DE |
| Cycle | SoSe |
| Content | |
| Literature | |



Specialization Process Engineering

Process engineering is the engineering discipline that conducts research into, develops, and realizes material change processes. It deals as a cross-sectional science with the conversion of materials in their nature, their properties, or their composition by means of physical, chemical, and biological processes with a view to producing usable intermediate or end products such as fuels, sugar, synthetics, proteins, cosmetics, dyestuffs, alcohols, plant protection products, or medications.

To achieve these targets, the process engineering study program aims to enable students to recognize and formulate laws by means of which apparatus, machinery, and entire manufacturing plants can be planned, calculated, designed, built, and operated. The product qualities required are to be achieved by means of safe and environmentally compatible processes and a rational use of energy and raw materials.

| Courses | | | | | |
|---|--|--------------------|----------------|---------|--|
| Title | | Тур | Hrs/wk | СР | |
| Introduction into Process Engineering/Bioprocess Engineering (L0829) Fundamentals of material engineering (L0830) | | Lecture Lecture | 2 2 | 1 2 | |
| Module Responsible | Prof. Michael Schlüter | | | | |
| Admission Requirements | INone | None | | | |
| Recommended Previous Knowledge | Inone | | | | |
| Educational Objectives After taking part successfully, students have reached the following learning results | | | | | |
| Professiona Competence | | the chiliby to | | | |
| give an overview of the most important fields on process and bioprocess engineering, explain some working methods for different fields in process engineering. Knowledge | | | | eering, | |
| Skills | After passing this module the students should have the ability to: • list and outline the most important fields of process engineering, • name the most important working approaches or methods of the different fields of process engineering, • read and prepare an engineering drawing, • explain the most important technologies for wastewater and exhaust air treatment • scheme typical chemical and biotechnological processes independently with the aid pointers. | | | | |
| Personal Competence | The students are able to | | | | |
| work out results in groups and document them, provide appropriate feedback and handle feedback on their own performance constru Social Competence | | | onstructively. | | |



| Autonomy | The students are able to estimate their progress of learning by themselves and to deliberate their lack of knowledge in Process Engineering and Bioprocess Engineering. |
|--------------------------------|---|
| Workload in Hours | Independent Study Time 34, Study Time in Lecture 56 |
| Credit points | 3 |
| Studienleistung | Compulsory Bonus Form Description Yes None Written elaboration |
| | Written exam |
| Examination duration and scale | 90 min |
| _ | General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering: Core qualification: Compulsory |

| Course L0829: Introduct | Course L0829: Introduction into Process Engineering/Bioprocess Engineering | | |
|-------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | | |
| Lecturer | Dozenten des SD V | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Introduction into the different research fields of the subject Process Engineering and Bioprocess Engineering. | | |
| Literature | s. StudIP | | |



| Course L0830: Fundame | entals of material engineering | | |
|-----------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Dr. Marko Hoffmann | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Introduction Atomic structure and bonding Structure of solids Miller indices Imperfections in solids Texture Diffusion Mechanical properties Dislocations and strengthening mechanisms Phase transformations Phase diagrams, iron-carbon phase diagram Metallic materials Corrosion Polymeric materials Ceramic materials | | |
| Literature | Bargel, HJ.; Schulze, G. (Hrsg.): Werkstoffkunde. Berlin u.a., Springer Vieweg, 2012. Bergmann, W.: Werkstofftechnik 1. München u.a., Hanser, 2009. Bergmann, W.: Werkstofftechnik 2. München u.a., Hanser, 2008. Callister, W. D.; Rethwisch, D. G.: Materialwissenschaften und Werkstofftechnik: eine Einführung, Übersetzungshrsg.: Scheffler, M., 1. Auflage, Weinheim, Wiley-VCH, 2013. Seidel, W. W., Hahn, F.: Werkstofftechnik. München u.a., Hanser, 2012. | | |



| Courses | | | | | | |
|-----------------------------------|---|---------------------------------------|----------------------|------------------|----------------|--|
| Title | | Т | у р | Hrs/wk | СР | |
| Physical Chemistry (L0833) | | | ecture | 2 | 2 | |
| Physical Chemistry (L0835) | | P | ractical Course | 2 | 1 | |
| Module Responsible | Prof. Hans-Ulrich Moritz | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous Knowledge | Contents of the previou | modules inorganic chemist | ry, physics for engi | neers and math | ematics I-III. | |
| Educational Objectives | After taking part succes | fully, students have reached | the following lear | ning results | | |
| Professional | | | | | | |
| Competence | The students are able | | | | | |
| | The students are able, | | | | | |
| | -to repeat the basic con | epts of physical chemistry | | | | |
| Knowledge | -to describe and summa | ize the underlying concepts | s of mass-, heat- ar | nd momentum tr | ansfer. | |
| | - to interpret phase diag | ams and affiliate kinetic rate | e laws. | | | |
| | The students are able to | | | | | |
| | - conduct (fundamental) | hermodynamical, electroch | emical and kinetic | calculations. | | |
| Skills | s - assess new applications with respect to environmental sustainability. | | | | | |
| | - abstract their knowldege to related issues to conduct thermodynamical, electrochemical and kineti | | | | | |
| | - abstract their knowlds calculations. | le to related issues to cond | luct thermodynamic | cai, electrochen | nicai and kine | |
| Personal Competence | | | | | | |
| · | The students are able to plan, prepare, conduct and document experiments according to guidelines in small groups. | | | ling to scient | | |
| Social Competence | The students are able t fellow students and fact | reflect their subject-specific ty. | c knowledge orally | in a team and t | o discuss it w | |
| Autonomy | Students are able to assess their knowldege continuously on their own by exemplified practice Students are able to apply their knowldege discretely to plan, prepare and conduct experiments. | | | | | |
| Workload in Hours | Independent Study Tim | 34, Study Time in Lecture 5 | 56 | | | |
| Credit points | 3 | | | | | |
| | Compulsory Bonus | Form | Description | | | |
| Studienleistung | Yes None | Subject theoretical practical work | and | | | |
| Examination | Written exam | | | | | |
| Examination duration and scale | 180 min | | | | | |
| | General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering Elective Compulsory Bioprocess Engineering: Core qualification: Elective Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering Compulsory General Engineering Science (English program, 7 semester): | | | | | |



Elective Compulsory
Process Engineering: Core qualification: Compulsory

| Course L0833: Physical | Chemistry | | | |
|------------------------|--|--|--|--|
| Тур | Lecture | | | |
| Hrs/wk | 2 | | | |
| СР | | | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | | |
| Lecturer | Prof. Volker Abetz | | | |
| Language | DE | | | |
| Cycle | WiSe | | | |
| Content | Content Con | | | |
| Literature | P. W. Atkins, J. de Paula: Physikalische Chemie, 5. Auflage, Wiley-VCH, 2013 P. W. Atkins, J. de Paula: Kurzlehrbuch Physikalische Chemie, 4. Auflage, Wiley-VCH, 2008 G. Wedler, HJ. Freund: Lehrbuch der Physikalischen Chemie, 6. Auflage, Wiley-VCH, 2012 R. Reich: Thermodynamik - Grundlagen u. Anwendungen in der allgemeinen Chemie, 2. Auflage, Wiley-VCH, 1993 U. Nickel: Lehrbuch der Thermodynamik - Eine verständliche Einführung, 2. Auflage, PhysChem-Verlag, 2011 | | | |



| Course L0 | 835: Physical Chemistry |
|-------------------|--|
| Тур | Practical Course |
| Hrs/wk | 2 |
| СР | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Prof. Volker Abetz |
| Language | DE |
| Cycle | WiSe |
| Content | Six laboratory experiments are conducted in groups of two students. The subjects of experimental investigations are: Reaction kinetics Freezing-point depression (cryoscopy) Electrical mobility of ions Viscosimetry Heat of neutralization Surface tension Before the practical conduct of the experiments a colloquium takes place in which the students explain, reflect and discuss the theoretical basics and their translation into practice. The students write up a report for every experiment. They receive feedback to their level of scientific writing (citation methods, labeling of graphs, etc.), so that they can improve their competence in this field over the course of the practical course. |
| Literature | Skript zum Chemiepraktikum III für Verfahrenstechniker, jeweils aktuelle Version, ca. 100 Seiten, PDF-Datei zum Download unter http://www.chemie.uni-hamburg.de/studium/nebenfach/tuhh3/studium/nebenfach/tuhha/studium/nebenfach/tuhha/studium/nebenfach/tuhha/studium/nebenfach/tuhha/studium/nebenf |



| Module M0730: Co | omputer Engineeri | ing | | | | |
|--|--|---|------------------------------------|------------------|----|--|
| Courses | | | | | | |
| Title | | | Тур | Hrs/wk | СР | |
| Computer Engineering (L03: Computer Engineering (L03: | | | Lecture Recitation Section (small) | 3 | 4 | |
| Module Responsible | Prof. Heiko Falk | | | | | |
| Admission Requirements | INone | | | | | |
| Recommended Previous Knowledge | The successful comple examination according to 1. Upon a passed marks due to the respectively, up | Basic knowledge in electrical engineering The successful completion of the labs will be honored during the evaluation of the module examination according to the following rules: 1. Upon a passed module examination, the student is granted a bonus on the examination marks due to the successful labs, such that the examination's marks are lifted by 0,3 or 0,4 respectively, up to the next-better grade. 2. The improvement of the grade 5,0 up to 4,3 and of 4,3 up to 4,0 is not possible. | | | | |
| Educational Objectives | After taking part success | sfully, students have reach | ed the following learning | results | | |
| Professional Competence | | | | | | |
| Knowledge | This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-level programming down to gates. The module includes the following topics: • Introduction • Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis combinational networks • Sequential logic: Flip-flops, automata, systematic hardware design • Technological foundations • Computer arithmetic: Integer addition, subtraction, multiplication and division • Basics of computer architecture: Programming models, MIPS single-cycle architecture pipelining • Memories: Memory hierarchies, SRAM, DRAM, caches • Input/output: I/O from the perspective of the CPU, principles of passing data, point-to-poin connections, busses The students perceive computer systems from the architect's perspective, i.e., they identify the internal | | | | | |
| Skills | structure and the physical composition of computer systems. The students can analyze, how highly specific and individual computers can be built based on a collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers of today's computing systems - from gates and circuits up to complete processors. After successful completion of the module, the students are able to judge the interdependencies between a physical computer system and the software executed on it. In particular, they shall understand the consequences that the execution of software has on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evaluate the impact that these low abstraction levels have on an entire system's performance and to propose feasible options. | | | | | |
| Personal Competence | <u> </u> | | | | | |
| Social Competence | Students are able to solve similar problems alone or in a group and to present the results accordingly | | | its accordingly. | | |
| Autonomy | Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. | | | | | |
| Workload in Hours | Independent Study Time | e 124, Study Time in Lectu | re 56 | | | |
| Credit points | 6 | | | | | |
| Studienleistung | Compulsory Bonus Yes 10 % | Form Excercises | Description | | | |
| Examination | Written exam | | | | | |



| Examination duration and scale | 90 minutes, contents of course and labs |
|--------------------------------|--|
| | General Engineering Science (German program): Core qualification: Compulsory General Engineering Science (German program, 7 semester): Specialisation Computer Science: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and |
| | Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Materials in Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Theoretical Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory |
| Accianment for the | Computer Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program): Core qualification: Compulsory |
| = | General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Mechatronics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Biomechanics: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircreft Systems Engineering, Compulsory |
| | Focus Aircraft Systems Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, |
| | Focus Energy Systems: Compulsory |



Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory

| Course L0321: Compute | r Engineering |
|-----------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Heiko Falk |
| Language | DE |
| Cycle | WiSe |
| Content | Introduction Combinational Logic Sequential Logic Technological Foundations Representations of Numbers, Computer Arithmetics Foundations of Computer Architecture Memories Input/Output |
| Literature | A. Clements. The Principles of Computer Hardware. 3. Auflage, Oxford University Press, 2000. A. Tanenbaum, J. Goodman. Computerarchitektur. Pearson, 2001. D. Patterson, J. Hennessy. Rechnerorganisation und -entwurf. Elsevier, 2005. |

| Course L0324: Computer Engineering | | |
|------------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Courses | | | | | | |
|--|--|---|---------------------------------------|---------|--------|--|
| Title | | | Тур | Hrs/wk | СР | |
| Fundamentals of Fluid Mecl Fluid Mechanics for Proces | , , | | Lecture Recitation Section (large) | 2 2 | 4 2 | |
| Module Responsible | Prof. Michael Schlüter | | | | | |
| Admission Requirements | INODA | | | | | |
| Recommended Previous Knowledge | Technical MechaTechnical ThermoWorking with forc | Mathematics I+II+III Technical Mechanics I+II Technical Thermodynamics I+II Working with force balances Simplification and solving of partial differential equations Integration | | | | |
| Educational Objectives | After taking part success | fully, students hav | e reached the following learning | results | | |
| Professional Competence | | | | | | |
| Knowledge | Students are able to: explain the difference between different types of flow give an overview for different applications of the Reynolds Transport-Theorem in process engineering explain simplifications of the Continuity- and Navier-Stokes-Equation by using physica boundary conditions | | | | | |
| Skills | describe and model incompressible flows mathematically reduce the governing equations of fluid mechanics by simplifications to archive quantitative solutions e.g. by integration notice the dependency between theory and technical applications use the learned basics for fluid dynamical applications in fields of process engineering | | | | | |
| Personal Competence | <u> </u> | | | | | |
| Social Competence | are capable to gather information from subject related, professional publications and relate tha information to the context of the lecture and able to work together on subject related tasks in small groups. They are able to present their results effectively in English (e.g. during small group exercises) are able to work out solutions for exercises by themselves, to discuss the solutions orally and to present the results. | | | | | |
| Autonomy | The students are able to search further literature for each topic and to expand their knowledge with this literature, work on their exercises by their own and to evaluate their actual knowledge with the feedback. | | | | | |
| Workload in Hours | Independent Study Time | 124, Study Time | n Lecture 56 | | | |
| Credit points | 6 | | | | | |
| Studienleistung | Compulsory BonusFormDescriptionYes5 %Midterm | | | | | |
| | Written exam | | | | | |
| Examination duration and scale | 3 hours | | | | | |



| | General Engineering Science (German program): Specialisation Energy and Environmental |
|---|---|
| Assignment for the Following Curricula | Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory |
| | Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Process Engineering: Core qualification: Compulsory |

| Course L0091: Fundame | entals of Fluid Mechanics |
|-----------------------|--|
| | Lecture |
| Hrs/wk | |
| СР | |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| | Prof. Michael Schlüter |
| Language | |
| Cycle | |
| Content | fluid properties hydrostatic overall balances - theory of streamline overall balances- conservation equations differential balances - Navier Stokes equations irrotational flows - Potenzialströmungen flow around bodies - theory of physical similarity turbulent flows compressible flows |
| Literature | Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994. Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006. Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008. Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007. Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008. Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011. |



| urse L0092: Fluid Med | chanics for Process Engineering |
|-----------------------|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Michael Schlüter |
| Language | DE |
| Cycle | SoSe |
| Content | In the exercise-lecture the topics from the main lecture are discussed intensively and transferred into application. For that, the students receive example tasks for download. The students solve these problems based on the lecture material either independently or in small groups. The solution is discussed with the students under scientific supervision and parts of the solutions are presented on the chalk board. At the end of each exercise-lecture, the correct solution is presented on the chalk board. Parallel to the exercise-lecture tutorials are held where the student solve exam questions under a set time-frame in small groups and discuss the solutions afterwards. |
| Literature | Crowe, C. T.: Engineering fluid mechanics. Wiley, New York, 2009. Durst, F.: Strömungsmechanik: Einführung in die Theorie der Strömungen von Fluiden. Springer-Verlag, Berlin, Heidelberg, 2006. Fox, R.W.; et al.: Introduction to Fluid Mechanics. J. Wiley & Sons, 1994. Herwig, H.: Strömungsmechanik: Eine Einführung in die Physik und die mathematische Modellierung von Strömungen. Springer Verlag, Berlin, Heidelberg, New York, 2006. Herwig, H.: Strömungsmechanik: Einführung in die Physik von technischen Strömungen: Vieweg+Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2008. Kuhlmann, H.C.: Strömungsmechanik: Grundlagen, Grundgleichungen, Lösungsmethoden, Softwarebeispiele. Vieweg+ Teubner Verlag / GWV Fachverlage GmbH, Wiesbaden, 2009. Schade, H.; Kunz, E.: Strömungslehre. Verlag de Gruyter, Berlin, New York, 2007. Truckenbrodt, E.: Fluidmechanik 1: Grundlagen und elementare Strömungsvorgänge dichtebeständiger Fluide. Springer-Verlag, Berlin, Heidelberg, 2008. Schlichting, H.: Grenzschicht-Theorie. Springer-Verlag, Berlin, 2006. van Dyke, M.: An Album of Fluid Motion. The Parabolic Press, Stanford California, 1882. White, F.: Fluid Mechanics, Mcgraw-Hill, ISBN-10: 0071311211, ISBN-13: 978-0071311212, 2011. |



| itle | | | | |
|--|---|--|--|--|
| hase Equilibria Thermody hase Equilibria Thermody | | Typ Lecture Recitation Section (small) | Hrs/wk 2 1 | CP 2 2 |
| hase Equilibria Thermody | | Recitation Section (large) | 1 | 2 |
| Module Responsible | Prof. Irina Smirnova | | | |
| Admissior Requirements | INONE | | | |
| Recommended Previous Knowledge | | ynamics I and II | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | g results | |
| Professiona Competence | | | | |
| Knowledge | Starting from the very basics of their describe thermodynamic equilibria. They learn how state variables are into quantitatively describe these proposed. Moreover, the students learn how play phenomena may occur if different Furthermore the fundamentals of reast For different phase equilibria, seven shown and the necessary knowledge. | nfluenced by the mixing of conerties. nase equilibria can be describent phases (vapor, liquid, so action equilibria are taught. ral examples relevant for diffe | npounds and did mathemat lid) coexist rent kinds o | l learn conceptically and which in equilibrium |
| Skills | Applying their knowledge, the studetermination of the equilibrium stat The students know models which caequilibrium state and they are able t For specific applications, they are properties of compounds as well as Beside pure compound properties mixtures. The students know how to visual interpret the occurring phenomena. Based on their knowledge, the stud the basis for many separation and residual interpret. | e and know how to simplify the an be used to determine the proposition of solve the resulting mathemate able to self-reliantly find remodel parameters in literature the students are capable of size phase equilibria graphical ents are able to understand fur | se equations operties of the control | meaningfully ne system in the nysico-chemic ne properties y know how |
| Personal Competence | | une to calve the correspondi | na problems | and to proce |
| Social Competence | them orally to the tutors and other students | | | |
| Autonom | The students are able to find necessary information self-reliantly in literature sources and judge their quality. During the semester the students are able to check their learning progress continuously exercises. Based on this knowledge the students can adept their learning process. | | | |



| Credit points Studienleistung | Rone |
|----------------------------------|---|
| Examination | Written exam |
| Examination duration and scale | I 120 minutes: ineoretical questions and calculations |
| • | General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory Process Engineering: Core qualification: Compulsory |

| ourse L0114: Phase Ed | quilibria Thermodynamics | | |
|-----------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Irina Smirnova | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Introduction: Applications of thermodynamics of mixtures Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule Equations of state: virial equations, van-der-Waals equation, generalized equations of state Mixing properties: ideal and real mixtures, excess properties, partial molar properties Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition Gas-liquid-equilibria: equilibrium condition, Henry-coefficient G^E-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems Solid-liquid-equilibria: equilibrium condition, binary systems Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature Osmotic pressure | | |
| Literature | Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992 J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O 'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005. | | |



| Course L0140: Phase Ed | quilibria Thermodynamics | | |
|------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Prof. Irina Smirnova | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Introduction: Applications of thermodynamics of mixtures Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule Equations of state: virial equations, van-der-Waals equation, generalized equations of state Mixing properties: ideal and real mixtures, excess properties, partial molar properties Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition Gas-liquid-equilibria: equilibrium condition, Henry-coefficient G^E-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems Solid-liquid-equilibria: equilibrium condition, binary systems Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature Osmotic pressure The students work on tasks in small groups and present their results in front of all students. | | |
| Literature | Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992 J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O 'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005. | | |



| Course L0142: Phase Ed | quilibria Thermodynamics | | | |
|------------------------|--|--|--|--|
| Тур | Recitation Section (large) | | | |
| Hrs/wk | 1 | | | |
| СР | | | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | | |
| Lecturer | Prof. Irina Smirnova | | | |
| Language | DE | | | |
| Cycle | SoSe | | | |
| Content | Introduction: Applications of thermodynamics of mixtures Thermodynamic equations in multi-component systems: Fundamental equations, chemical potential, fugacity Phase equilibria of pure substances: thermodynamic equilibrium, vapor pressure, Gibbs' phase rule Equations of state: virial equations, van-der-Waals equation, generalized equations of state Mixing properties: ideal and real mixtures, excess properties, partial molar properties Vapor-liquid-equilibria: binary systems, azeotropes, equilibrium condition Gas-liquid-equilibria: equilibrium condition, Henry-coefficient G^E-Models: Hildebrand-model, Flory-Huggins-model, Wilson-model, UNIQUAC, UNIFAC Liquid-liquid-equilibria: equilibrium condition, phase equilibria in binary and ternary systems Solid-liquid-equilibria: equilibrium condition, binary systems Chemical reactions: reaction coordinate, mass action law, influence of pressure and temperature Osmotic pressure | | | |
| Literature | Jürgen Gmehling, Bärbel Kolbe: Thermodynamik. VCH 1992 J.M. Prausnitz, R.N. Lichtenthaler, E.G. de Azevedo: Molecular Thermodynamics of Fluid-Phase Equilibria, 3rd ed. Prentice Hall, 1999. J.W. Tester, M. Modell: Thermodynamics and its Applications. 3rd ed. Prentice Hall, 1997.J.P. O 'Connell, J.M. Haile: Thermodynamics. Cambridge University Press, 2005. | | | |



| courses | | | | |
|--------------------------------|---|--|---|--|
| itle itle | | Тур | Hrs/wk | СР |
| signals and Systems (L043) | | Lecture | 3 | 4 |
| signals and Systems (L043) | 3) | Recitation Section (small) | 2 | 2 |
| Module Responsible | Prof. Gerhard Bauch | | | |
| Admission Requirements | | | | |
| | Mathematics 1-3 | | | |
| | The modul is an introduction to the theor covered by the moduls Mathematik 1-3 is a (Fourier series, Fourier transform, Laplace t | expected. Further experience w | ith spectral | - |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The students are able to classify and described methods of signal and system theory. The continuous-time and discrete-time signals a signals and systems mathematically in both effects in time domain and image domain signal to a discrete-time signal. | ey are able to apply the fund and systems. They can describe time and image domain. In par | amental tra e and analy ticular, they | nsformations o se deterministi understand th |
| Skills | The students are able to describe and analusing methods of signal and system theor important properties such as magnitude an the impact of LTI systems on the signal prop | y. They can analyse and desigd phase response, stability, line | n basic sys earity etc T | stems regardin |
| Personal Competence | | | | |
| Social Competence | The students can jointly solve specific probl | ems. | | |
| Autonomy | The students are able to acquire relevant control their level of knowledge during the clicker system. | | | - |
| Workload in Hours | Independent Study Time 110, Study Time ir | Lecture 70 | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 190 min | | | |
| | General Engineering Science (German progeneral Engineering Science (German Engeneering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German progeneral Engineering Science | gram): Specialisation Computer gram): Specialisation Process E gram): Specialisation Bioproces no program): Specialisation no program): Specialisation no program): Specialisation Biomedical gram): Specialisation Biomedical gram, 7 semester): Specialisation gram, 7 semester): Specialisation program, 7 semes | Science: Congineering: se Engineering Civil- and Mechanica al Engineering tion Electrical sation Congation Proces | ompulsory Compulsory ng: Compulsor Enviroment I Engineering ng: Compulsor al Engineering puter Science |



Focus Biomechanics: Compulsory

Assignment for the

Following Curricula

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering,

Focus Theoretical Mechanical Engineering: Compulsory

Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory

General Engineering Science (English program): Specialisation Civil- and Enviromental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory



| Course L0432: Signals a | and Systems | | |
|-------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 3 | | |
| СР | | | |
| | Independent Study Time 78, Study Time in Lecture 42 | | |
| Lecturer Language | Prof. Gerhard Bauch | | |
| Cycle | | | |
| Content | Basic classification and description of continuous-time and discrete-time signals and systems Concvolution Power and energy of signals Correlation functions of deterministic signals Linear time-invariant (LTI) systems Signal transformations: Fourier-Series Fourier Transform Laplace Transform Discrete-time Fourier Transform Discrete Fourier Transform (DFT), Fast Fourier Transform (FFT) Z-Transform Analysis and design of LTI systems in time and frequency domain Basic filter types Sampling, sampling theorem Fundamentals of recursive and non-recursive discrete-time filters | | |
| Literature | T. Frey , M. Bossert , Signal- und Systemtheorie, B.G. Teubner Verlag 2004 K. Kammeyer, K. Kroschel, Digitale Signalverarbeitung, Teubner Verlag. B. Girod ,R. Rabensteiner , A. Stenger , Einführung in die Systemtheorie, B.G. Teubner Stuttgart, 1997 J.R. Ohm, H.D. Lüke , Signalübertragung, Springer-Verlag 8. Auflage, 2002 S. Haykin, B. van Veen: Signals and systems. Wiley. Oppenheim, A.S. Willsky: Signals and Systems. Pearson. Oppenheim, R. W. Schafer: Discrete-time signal processing. Pearson. | | |



| course L0433: Signals and Systems | | |
|-----------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Gerhard Bauch | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| ourses | | | | | | |
|---|--|---|--|-------------------------------------|----------------------------------|---|
| itle | undomontolo (LOGA1) | | | yp | Hrs/wk | CP |
| lioprocess Engineering - Fu lioprocess Engineering- Fu | | | | ecture ecitation Section (large) | 2 | 3 1 |
| ioprocess Engineering - Fu | ındamental Practical Course (| L0843) | Р | ractical Course | 2 | 2 |
| Module Responsible | | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous Knowledge | none, module "organic ch | emistry", modu | ule "fundame | entals for process engin | eering" | |
| Educational Objectives | After taking part successfu | ılly, students h | ave reached | the following learning | results | |
| Professional Competence | | | | | | |
| Knowledge | Students are able to describe the basic concepts of bioprocess engineering. They are able to classif different types of kinetics for enzymes and microorganisms, as well as to differentiate different types of inhibition. The parameters of stoichiometry and rheology can be named and mass transport processe in bioreactors can be explained. The students are capable to explain fundamental bioproces management, sterilization technology and downstream processing in detail. | | | | | |
| Skills | corresponding par predict qualitativel growth inhibition o analyze bioproces distinguish betwee aerobic as well a biotechnical proble propose solutions models to explore new know identify scientific p | kinetic approrameters y the influence n the fermenta ses on basis ce en scale-up ce as microaerobem to complicated owledge resouroblems with ce | e of energy (ation process of stoichiome oriteria for di oic) to comp d biotechnol arces and to a concrete indu | rowth and substrate-up | metabolic for the state solution | equivalents and a set of the set |
| Personal Competence Social Competence | After completion of this n teams to enhance the ab | oility to take p | osition to th | eir own opinions and | - | |
| Autonomy | teamwork in engineering and scientific environments. After completion of this module participants will be able to solve a technical problem in a tear independently by organizing their workflow and to present their results in a plenum. | | | | | |
| Workload in Hours | Independent Study Time S | 96, Study Time | e in Lecture 8 | 34 | | |
| Credit points | 6 | | | | | |
| Studienleistung | Compulsory Bonus Form Description | | | | | |
| Examination | Written exam | | | | | |
| Examination duration and scale | 90 min | | | | | |

Compulsory



| | General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory |
|---------------------|---|
| | Bioprocess Engineering: Core qualification: Compulsory |
| | General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory |
| | General Engineering Science (English program): Specialisation Process Engineering: Compulsory |
| Assignment for the | General Engineering Science (English program, 7 semester): Specialisation Process Engineering: |
| Following Curricula | Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: |
| | Compulsory |
| | Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Compulsory |
| | Biomedical Engineering: Specialisation Implants and Endoprostheses: Elective Compulsory |
| | Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory |
| | Biomedical Engineering: Specialisation Management and Business Administration: Elective |
| | Compulsory |
| | Technomathematics: Specialisation III. Engineering Science: Elective Compulsory |
| | Process Engineering: Core qualification: Compulsory |

| Course L0841: Bioprocess Engineering - Fundamentals | | |
|---|---|--|
| Typ Lecture | | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Andreas Liese, Prof. An-Ping Zeng | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Introduction: state-of-the-art and development trends in the biotechnology, introduction to the lecture Enzyme kinetics: Michaelis-Menten, differnt types of enzyme inhibition, linearization, conversion, yield, selectivity (Prof. Liese) Stoichiometry: coefficient of respiration, electron balance, degree of reduction, coefficient of yield, theoretical oxygen demand (Prof. Liese) Microbial growth kinetic: batch- and chemostat culture (Prof. Zeng) Kinetic of subtrate consumption and product formation (Prof. Zeng) Rheology: non-newtonian fluids, viscosity, agitators, energy input (Prof. Liese) Transport process in a bioreactor (Prof. Zeng) Technology of sterilization (Prof. Zeng) Fundamentals of bioprocess management: bioreactors and calculation of batch, fed-batch and continuouse bioprocesses (Prof. Zeng/Prof. Liese) Downstream technology in biotechnology: cell breakdown, zentrifugation, filtration, aqueous two phase systems (Prof. Liese) | |
| Literature | K. Buchholz, V. Kasche, U. Bornscheuer: Biocatalysts and Enzyme Technology, 2. Aufl. Wiley-VCH, 2012 H. Chmiel: Bioprozeßtechnik, Elsevier, 2006 R.H. Balz et al.: Manual of Industrial Microbiology and Biotechnology, 3. edition, ASM Press, 2010 H.W. Blanch, D. Clark: Biochemical Engineering, Taylor & Francis, 1997 P. M. Doran: Bioprocess Engineering Principles, 2. edition, Academic Press, 2013 | |



| Course L0842: Bioprocess Engineering- Fundamentals | | |
|--|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | |
| Lecturer | Prof. Andreas Liese, Prof. An-Ping Zeng | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Introduction (Prof. Liese, Prof. Zeng) Enzymatic kinetics (Prof. Liese) Stoichiometry I + II (Prof. Liese) Microbial Kinetics I+II (Prof. Zeng) Rheology (Prof. Liese) Mass transfer in bioprocess (Prof. Zeng) Continuous culture (Chemostat) (Prof. Zeng) Sterilisation (Prof. Zeng) Downstream processing (Prof. Liese) Repetition (Reserve) (Prof. Liese, Prof. Zeng) | |
| Literature | | |
| Literature | siehe Vorlesung | |

| Course L0843: Bioprocess Engineering - Fundamental Practical Course | | |
|---|--|--|
| Тур | Practical Course | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Andreas Liese, Prof. An-Ping Zeng | |
| Language | DE | |
| Cycle | SoSe | |
| Content | In this course fermentation and downstream technologies on the example of the production of an enzyme by means of a recombinant microorganism is learned. Detailed characterization and simulation of enzyme kinetics as well as application of the enzyme in a bioreactor is carried out. The students document their experiments and results in a protocol. | |
| Literature | Skript | |



| Courses | | | | |
|---|--|--|--|--|
| Title Heat and Mass Transfer (Li Heat and Mass Transfer (Li Heat and Mass Transfer (L | 0102) | Typ Lecture Recitation Section (small) Recitation Section (large) | Hrs/wk 2 1 | CP 2 2 2 |
| Module Responsible | <u>, </u> | Treditation decition (targe) | ' | |
| Admission Requirements | | | | |
| Recommended Previous Knowledge | Basic knowledge: Technical Thermodyna | umics | | |
| Educational Objectives | After taking part successfully, students ha | ve reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | The students are capable of explain procedural apparatus (e.g. heat explain the procedural procedural | exchanger, chemical reactors). And characterize different kinds of the second state of the second s | of heat trans ass transfer ass trans | fer mechanism in detail and t sfer theories. |
| Skills | The students are able to set reasonable system boundaries for a given transport proble using the gained knowledge and to balance the corresponding energy and mass respectively. They are capable to solve specific heat transfer problems (e.g. heated chemical read temperature alteration in fluids) and to calculate the corresponding heat flows. Using dimensionless quantities, the students can execute scaling up of technical process apparatus. They are able to distinguish between diffusion, convective mass transition and mass transition and mass transition and tesign of apparatus (e.g. extracolumn, rectification column). In this context, the students are capable to choose and design fundamental types of heat mass exchanger for a specific application considering their advantages and disadvanta respectively. In addition, they can calculate both, steady-state and non-steady-state processes in proce apparatus. The students are capable to connect their knowledge obtained in this course with knowl of other courses (In particular the courses thermodynamics, fluid mechanics and chell process engineering) to solve concrete technical problems. | | emical reactors cal processes of d mass transfe (e.g. extraction rpes of heat an disadvantages es in procedura with knowlegd | |
| Personal Competence Social Competence | The students are capable to work results orally in a reasonable man | | in teams an | d to present th |
| | The students are able to find and of the the the the the the the the the the | evel of knowledge during the | course with | accompanyin |



| Autonomy | control their learning processes. | |
|---|---|--|
| | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | |
| Credit points | 6 | |
| Studienleistung | | |
| Examination | Written exam | |
| Examination duration and scale | L120 minutes: theoretical questions and calculations | |
| Assignment for the Following Curricula | 11-anarai Enginaaring Scianca (English program), Spacialisation Bioprocass Enginaaring, Compilisory | |



| Course L0101: Heat and Mass Transfer | | |
|--------------------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Irina Smirnova | |
| Language | DE | |
| Cycle | WiSe | |
| Content | 1. Heat transfer Introduction, one-dimensional heat conduction Convective heat transfer Multidimensional heat conduction Non-steady heat conduction Thermal radiation Mass transfer one-way diffusion, equimolar countercurrent diffusion boundary layer theory, non-steady mass transfer Heat and mass transfer single particle/ fixed bed Mass transfer and chemical reactions | |
| Literature | H.D. Baehr und K. Stephan: Wärme- und Stoffübertragung, Springer VDI-Wärmeatlas | |

| Course L0102: Heat and Mass Transfer | | |
|--------------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Irina Smirnova | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L1868: Heat and Mass Transfer | |
|--------------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Irina Smirnova |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Courses | | | | |
|-----------------------------------|---|---|--|---|
| Title | | Тур | Hrs/wk | СР |
| Thermal Separation Process | ses (L0118) | Lecture | 2 | 2 |
| Thermal Separation Process | ses (L0119) | Recitation Section (small) | 2 | 2 |
| Thermal Separation Process | | Recitation Section (large) | 1 | 1 |
| Separation Processes (L115 | 59) | Practical Course | 1 | 1 |
| Module Responsible | Prof. Irina Smirnova | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Recommended requirements: Thermodynan | nics III | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | |
| Professional Competence | <u>.</u> | | | |
| Knowledge | The students develop an understan process, the estimation of the energy and the selection of separation syste They have good knowledge of design | y demand of a process, the poms | ssibilities of | energy savin |
| Skills | Using the gained knowledge the stude separation process and can close the The students can use different grap and define the amount of theoreticals. They can select and design a basic ton the advantages and disadvantage. The students are capable to obtate appropriate sources (diagrams and to the students are able to prove their to the students are able to discuss experimental work with the teachers of the students are capable of linking their gains it together for the solution of technical prechanics and chemical engineering. | e associated energy and materi hical methods for the designir stages required ype of thermal separation products as of the process in independently the needed ables) iscontinuous processes neoretical knowledge in the exp to the theoretical background in colloquium. | al balances ng of a sep ess for a given material perimental is and the | aration proces ven case base properties fro ab work. content of the |
| Personal Competence | | | | |
| Social Competer | The students can work technical a results in the tutorial | ssignments in small groups a | and present | t the combine |
| Social Competence | The students are able to carry out pr division of labor between them. The scientifically in a report. | | _ | |
| Autonomy | The students are capable to obtathemselves and assess their quality The students can proof the state of the this way control their learning proces | neir knowledge with exam rese | | |



| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 | |
|---|---|--|
| Credit points | 6 | |
| Studienleistung | | |
| Examination | Written exam | |
| Examination duration and scale | 120 minutes; theoretical questions and calculations | |
| Assignment for the Following Curricula | General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering: Core qualification: Compulsory Bioprocess Engineering: Core qualification: Compulsory General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory | |



| ourse L0118: Thermal Separation Processes | | | |
|---|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Irina Smirnova | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes | | |
| Literature | G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 37985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry's Chemical Engineers' Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.) 6th ed., McGraw-Hill, New York 1984 Ullmann's Enzyklopädie der Technischer Chemie | | |



| ourse L0119: Thermal Separation Processes | | | |
|---|--|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Irina Smirnova | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes The students work on tasks in small groups and present their results in front of all students. | | |
| Literature | G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie | | |



| ourse L0141: Thermal Separation Processes | | | |
|---|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Irina Smirnova | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes | | |
| Literature | G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed. McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie | | |



| ourse L1159: Separatio | on Processes | |
|------------------------|---|--|
| Тур | Practical Course | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Irina Smirnova | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | The students work on eight different experiments in this practical course. For every one of the eight experiments, a colloquium takes place in which the students explain and discuss the theoretical background and its translation into practice with staff and fellow students. The students work small groups with a high degree of division of labor. For every experiment, the students write a report. They receive instructions in terms of scientific writing as well as feedback on their own reports and level of scientific writing so they can increase their capabilities in this area. Topics of the practical course: Introduction in the thermal process engineering and to the main features of separation processes Simple equilibrium processes, several steps processes Distillation of binary mixtures, enthalpy-concentration diagrams Extractive and azeotrope distillation, water vapor distillation, stepwise distillation Extraction: separation ternary systems, ternary diagram Multiphase separation including complex mixtures Designing of separation devices without discrete stages Drying Chromatographic separation processes Membrane separation Energy demand of separation processes Advance overview of separation processes Selection of separation processes | |
| Literature | G. Brunner: Skriptum Thermische Verfahrenstechnik J. King: Separation Processes, McGraw-Hill, 2. Aufl. 1980 Sattler: Thermische Trennverfahren, VCH, Weinheim 1995 J.D. Seader, E.J. Henley: Separation Process Principles, Wiley, New York, 1998. Mersmann: Thermische Verfahrenstechnik, Springer, 1980 Grassmann, Widmer, Sinn: Einführung in die Thermische Verfahrenstechnik, 3. Aufl., Walter de Gruyter, Berlin 1997 Brunner, G.: Gas extraction. An introduction to fundamentals of supercritical fluids and the application to separation processes. Steinkopff, Darmstadt; Springer, New York; 1994. ISBN 3-7985-0944-1; ISBN 0-387-91477-3. R. Goedecke (Hrsg.): Fluid-Verfahrenstechnik, Wiley-VCH Verlag, Weinheim, 2006. Perry"s Chemical Engineers" Handbook, R.H. Perry, D.W. Green, J.O. Maloney (Hrsg.), 6th ed., McGraw-Hill, New York 1984 Ullmann"s Enzyklopädie der Technischen Chemie | |



| Module M0892: Ch | nemical Reaction | Engineeri | ng | | | |
|--|---|---|---|--|---|--|
| Courses | | | | | | |
| Title | | | | Тур | Hrs/wk | СР |
| Chemical Reaction Engineer | ring (Fundamentals) (L0204 | 4) | | Lecture | 2 | 2 |
| Chemical Reaction Engineering (Fundamentals) (L0244) | | | | Recitation Section (large) | 2 | 2 |
| Experimental Course Chem | ical Engineering (Fundame | ntals) (L0221) | | Practical Course | 2 | 2 |
| Module Responsible | Prof. Raimund Horn | | | | | |
| Admission Requirements | None | | | | | |
| | Contents of the previou as well as computation | | | I, physical chemistry, ted | chnical ther | modynamics I+I |
| Educational Objectives | After taking part succes | sfully, student | ts have reache | ed the following learning | results | |
| Professional Competence | | | | | | |
| Knowledge | The students are able to explain basic concepts of chemical reaction engineering. They are able to point out differences between thermodynamical and kinetical processes. The students have a strong ability to outline parts of isothermal and non-isothermal ideal reactors and to describe their properties. | | | | | |
| | After successful comple | etion of the mo | dule, students | are able to: | | |
| | - apply different compu | tational metho | ds to dimension | on isothermal and non-is | sothermal id | eal reactors, |
| Skills | - determine and compu | te stable oper | ation points fo | r these reactors, | | |
| | - conduct experiments guidelines. | s on a lab-s | cale pilot pla | ants and document the | ese accordi | ng to scientific |
| Personal Competence | | | | | | |
| Social Competence | After successful completition of the lab-course the students have a strong ability to organize themselfes in small groups to solve issues in chemical reaction engineering. The students can discuss their subject related knowledge among each other and with their teachers. | | | | | |
| Autonomy | 71 | | | and assess their relevar re and conduct experim | | nously. Students |
| Workload in Hours | Independent Study Tim | e 96, Study Ti | me in Lecture | 84 | | |
| Credit points | 6 | | | | | |
| | Compulsory Bonus | Form | | Description | | |
| Studienleistung | Yes None | Subject practical v | theoretical vork | and | | |
| Examination | Written exam | | | | | |
| Examination duration and scale | 120 min | | | | | |
| _ | General Engineering S General Engineering S Compulsory General Engineering S Compulsory Bioprocess Engineering S General Engineering S General Engineering S General Engineering S General Engineering S Compulsory | cience (Germ Science (Germ cience (Germ g: Core qualifi cience (Englis cience (Englis Science (Englis | an program): Sman program, an program, 7 cation: Compush program): Sish program): Sish program, sh program, 7 | pecialisation Bioproces pecialisation Process E 7 semester): Specialisation semester): Specialisation | as Engineeri ation Proces on Bioproce s Engineering: ation Proces | ng: Compulsory ss Engineering: ss Engineering: ng: Compulsory Compulsory ss Engineering: |

| Course L0204: Chemical Reaction Engineering (Fundamentals) | |
|--|--|
| Typ Lecture | |



| | Mamburet Initiates of Torbook |
|-------------------|--|
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Raimund Horn |
| Language | DE |
| Cycle | WiSe |
| | Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, |

reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures)

Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, elementspecies-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)

Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)

Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate of change of species mole number, Arrhenius-equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhlernumber, differential and integral method of kinetic analysis, laboratory reactors for kinetic Content measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)

Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)

Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, molebalance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors)

non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)

lecture notes Raimund Horn

skript Frerich Keil

Books:



| M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Che | mie, |
|--|------|
| Wiley-VCH | |

- G. Emig, E. Klemm, Technische Chemie, Springer
- A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
- E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
- J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH
- H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
- H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall

Literature

- O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998
- L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
- J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
- R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
- M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill
- G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010
- A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH

| Course L0244: Chemical Reaction Engineering (Fundamentals) | |
|--|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Raimund Horn, Dr. Oliver Korup |
| Language | DE |
| Cycle | WiSe |
| | l e e e e e e e e e e e e e e e e e e e |

Fundamentals of chemical reaction engineering, definitions, calculation of species concentrations (reactor, reaction mixture, reactants, products, inerts and solvents, reaction volume, Reaktor volume, chemical reaction, mass, moles, mole fraction, volume, density, molar concentration, mass-concentration, molality, partial pressure, hydrodynamic residence time, space time, extent of reaction, reactor throughput, reactor load, conversion, selectivity, yield, concentration calculations in stationary and flowing multicomponent-mixtures)

Stoichiometry and stoichiometric calculations (simple reactions, complex reactions, key reactions, key species, matrix of stoichiometric coefficients, linear dependent and independent reactions, element-species-matrix, row reduced form of a matrix, rank of a matrix, Gauss Jordan elimination, relation between stoichiometry and kinetics, calculating the extent of reaction from mole number changes in complex reactions)

Thermodynamics (What is thermodynamics?, importance of thermodynamics in chemical reaction engineering, zeroth law of thermodynamics, temperature scales, temperature measurements in praxis, first law of thermodynamics, internal energy, enthalpy, calorimeter, heat of reaction, standard heat of formation, Hess law, heat capacity, Kirchhoff law, standard heat of reaction, pressure dependence of the heat of reaction, second law of thermodynamics, reversible and irreversible processes, entropy, Clausius inequality, free energy, Gibbs Energy, chemical potential, chemical equilibrium, activity, van't Hoff law, calculation of chemical equilibrium, principle of Le Chatelier and Braun, equilibrium calculations in multiple reaction systems, Lagrange Multipliers)

Chemical kinetics (reversible and irreversible reactions, homogeneous and heterogeneous reactions, elementary step, reaction mechanism, microkinetics, macrokinetics, formal kinetics, reaction rate, rate



Content

of change of species mole number, Arrhenius-equation, activation energy and pre-exponential factor for komplex reactions, reactions of 0., 1. and 2. order, analytical integration of rate laws, Damköhler-number, differential and integral method of kinetic analysis, laboratory reactors for kinetic measurements, half life, kinetics of complex reactions, parallel reactions, reversible reactions, sequence of reactions, irreversible reaction with pre-equilibrium, reduction of reaction mechanisms, quasi-stationarity principle of Bodenstein, rate limiting step, Michaelis-Menten kinetics, analytical integration of first order differential equations - integrating factor, numerical integration of complex kinetics)

Types of chemical Reaktors (chemical reactors in industry and laboratory, ideal vs. real reaktors, discontinuous, half continuous and continuous reactors, single phase - biphasic- and multiphase reactors, batch-reactor, semi-batch reactor, CSTR, Plug Flow reactor, fixed bed reactor, adiabatic staged reactors, rotating furnaces, fluidized bed reactors, gas-liquid-reactors, multi-phase reactors)

Isothermal ideal reactors (mole-balance of a chemical reactor, mole balance of a batch reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of the semi-batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of plug flow reactors for reactions with volume change and complex reactions, mole balance of a fixed bed reactor, design of a membrane reactor, mole balance of a continuously stirred tank reactor, comparison of CSTR and PFR with respect to conversion and selectivity, molebalance of a cascade of tank reactors, numerical-interative calculation of a cascade of tank reactors, Newton-Raphson method, graphical analysis of a cascade of tank reactors)

non-isothermal ideal reactors (energy balance of a reactor, adiabatic reactor, adiabatic temperature rise, staged reactor for adiabatic exothermic reactions limited by chemical equilibrium, design of an adiabatic plug flow reactor, Levenspiel-plots, heat transfer through a reactor wall, heat transfer by convection, heat conduction, heat transfer through a cylindrical wall, design of a plug flow reactor in parallel and counter flow, heat balance of the cooling fluid, CSTR with heat exchange, multiple stationary states, ignition-extinction behavior, stability of a CSTR, complex reactions in non-isothermal reactors, optimum temperature profile of a reactor)

lecture notes Raimund Horn

skript Frerich Keil

Books:

- M. Baerns, A. Behr, A. Brehm, J. Gmehling, H. Hofmann, U. Onken, A. Renken, Technische Chemie, Wiley-VCH
- G. Emig, E. Klemm, Technische Chemie, Springer
- A. Behr, D. W. Agar, J. Jörissen, Einführung in die Technische Chemie
- E. Müller-Erlwein, Chemische Reaktionstechnik 2012, 2. Auflage, Teubner Verlag
- J. Hagen, Chemiereaktoren: Auslegung und Simulation, 2004, Wiley-VCH

Literature

- H. S. Fogler, Elements of Chemical Reaction Engineering, Prentice Hall B
- H. S. Fogler, Essentials of Chemical Reaction Engineering, Prentice Hall
- O. Levenspiel, Chemical Reaction Engineering, John Wiley & Sons, 1998
- L. D. Schmidt, The Engineering of Chemical Reactions, Oxford Univ. Press, 2009
- J. B. Butt, Reaction Kinetics and Reactor Design, 2000, Marcel Dekker
- R. Aris, Elementary Chemical Reactor Analysis, Dover Pubn. Inc., 2000
- M. E. Davis, R. J. Davis, Fundamentals of Chemical Reaction Engineering, McGraw Hill
- G. F. Froment, K. B. Bischoff, J. De Wilde, Chemical Reactor Analysis and Design, John Wiley & Sons, 2010
- A. Jess, P. Wasserscheid, Chemical Technology An Integrated Textbook, WILEY-VCH



| ourse L0221: Experime | ental Course Chemical Engineering (Fundamentals) |
|-----------------------|---|
| Тур | Practical Course |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Raimund Horn, Dr. Achim Bartsch |
| Language | DE/EN |
| Cycle | SoSe |
| Content | Performing and evaluation of experiments concerning chemical reaction engineering with emphasis on ideal reactors: * Batch reactor - Estimation of kinetic parameters for the saponification of ethylacetate * CSTR - Residence time distribution, reaction * CSTR in Series - Residence time distribution, reaction * Plug Flow Reactor - Residence time distribution, reaction Before the practical conduct of the experiments a colloquium takes place in which the students explain, reflect and discuss the theoretical basics and their translation into practice. The students write up a report for every experiment. They receive feedback to their level of scientific writing (citation methods, labeling of graphs, etc.), so that they can improve their competence in this field over the course of the practical course. |
| Literature | Levenspiel, O.: Chemical reaction engineering; John Wiley & Sons, New York, 3. Ed., 1999 VTM 309(LB) Praktikumsskript Skript Chemische Verfahrenstechnik 1 (F.Keil) |



| Courses | | | | |
|---------------------------------------|---|---|--|--|
| Measurement Technology for | nent and Control Systems (L1119) or Mechanical and Process Engineers (L1116) or Mechanical and Process Engineers (L1118) | Typ Practical Course Lecture Recitation Section (large) | Hrs/wk 2 2 1 | CP 2 3 |
| Module Responsible | | (1.3-) | | |
| Admission Requirements | None | | | |
| · · · · · · · · · · · · · · · · · · · | Basic knowledge of physics, chemistry and electrical engineering | | | |
| | After taking part successfully, students have | reached the following learning | results | |
| Professional Competence | | | | |
| | Students are able to name the most important fundmentals of the Measurement Te (Quantities and Units, Uncertainty, Calibration, Static and Dynamic Properties of Ser Systems). | | | |
| Knowledge | They can outline the most important me maesured (Electrical Quantities, Temperature) | • | | |
| | They can describe important methods of Chromatography) | of chemical Analysis (Gas Se | ensors, Spe | ctroscopy, G |
| Skills | solution approaches as well as place the issues into the right context and application area. | | | |
| Personal Competence | | | | |
| Social Competence | • , | | · | |
| Autonomy | Students are able to familiarize themselves | with new measurement technol | ogies. | |
| | Independent Study Time 110, Study Time in | Lecture 70 | | |
| Credit points | | | | |
| Studienleistung | Yes None Form Subject the operation practical work | Description oretical and | | |
| Examination | Written exam | | | |
| Examination duration and scale | 105 minutes | | | |
| | General Engineering Science (German Engineering: Compulsory General Engineering Science (German Compulsory General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German Environmental Engineering: Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory General Engineering Science (German pro Compulsory | n program): Specialisation gram): Specialisation Biomedica gram): Specialisation Process E n program, 7 semester): Specialisation | Mechanica al Engineering: ingineering: pecialisation on Mechanic | Engineerir ng: Compulsor Compulsory Energy a al Engineerir |



General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

Assignment for the Following Curricula

Assignment for the Energy and Environmental Engineering: Core qualification: Compulsory

General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Process Engineering: Core qualification: Compulsory



| Тур | Practical Course |
|-------------------|---|
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | NN |
| Language | DE |
| Cycle | WiSe/SoSe |
| | Experiment 1: Emission and immission measurement of gaseous pollutants: different technologie determine different gaseous pollutants in automotive exhaust are used. |
| Content | Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dyna behaviour of e pump engine will be investigated. The starting will be simulated on a PC and compa with measurement. |
| | Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will understood and applications with Michelson interferometer and optical fibers demonstrated. |
| | Experiment 4:Identification of the parameters of a control system and optimal control parameters |
| | Versuch 1: Leith, W.: Die Analyse der Luft und ihrer Verunreinigung in der freien Atmosphäre und Arbeitsplatz. 2. Aufl., Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974 Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmi Luftverunreinigungen. R. Oldenburg Verlag, München-Wien, 1979 Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenhei Naturschutz und Umweltgestaltung Gebrauchs- und Bedienungsanweisungen VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.455 Bl.1 Versuch 2: Grundlagen über elektrische Maschinen, speziell: Asynchronmotoren |
| Literature | Grundlagen über elektrische Maschinen, speziell: Asynchroninloben Simulationsmethoden, speziell: Verwendung von Blockschaltbildern Betriebsverhalten von Kreispumpen, speziell: Kennlinien, Ähnlichkeitsgesetze Versuch 3: |
| | Unger, HG.: Optische Nachrichtentechnik, Teil 1: Optische Wellenleiter. Hüthing Ver Heidelberg, 1984 Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech Ho Boston, 1988 Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Bos 1989 |
| | Versuch 4: Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelunge |



| Tvn | Lecture |
|-------------------|--|
| Hrs/wk | |
| СР | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Dr. Sven Krause |
| Language | |
| Cycle | |
| | 1 Fundamentals 1.1 Quantities and Units |
| | 1.2 Uncertainty |
| | 1.3 Calibration |
| | 1.4 Static and Dynamic Properties of Sensors and Systems |
| | 2 Measurement of Electrical Quantities |
| | 2.1 Current and Voltage |
| | 2.2 Impedance |
| | 2.3 Amplification |
| | 2.4 Oscilloscope |
| | 2.5 Analog-to-Digital Conversion |
| Comtout | 2.6 Data Transmission |
| Content | 3 Measurement of Nonelectric Quantities |
| | 3.1 Temperature |
| | 3.2 Length, Displacement, Angle |
| | 3.3 Strain, Force, Pressure |
| | 3.4 Flow |
| | 3.5 Time, Frequency |
| | 4 Chemical Analysis |
| | 4.1 Gas Sensors |
| | 4.2 Spectroscopy |
| | 4.3 Gas Chromatography |
| | At the end of each lecture students present single measuring techniques and results orally in from the class. |
| | Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Spring 2006, ISBN: 978-3-540-34055-3. |
| Literature | Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 9 3486217940. |



| Course L1118: Measure | ourse L1118: Measurement Technology for Mechanical and Process Engineers | |
|-----------------------|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dr. Sven Krause | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |



| Γitle | | Тур | Hrs/wk | СР |
|--|--|---|----------------|------------------|
| ntroduction to Control Syste ntroduction to Control Syste | , , | Lecture Recitation Section (sma | 2 all) 2 | 4 2 |
| Module Responsible | Prof. Herbert Werner | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | | systems in time and frequency domain, L | aplace transfo | rm |
| Educational Objectives | After taking part successfully, s | students have reached the following learn | ing results | |
| Professional Competence | | | | |
| Knowledge | Students can represent dynamic system behavior in time and frequency domain, and can in particular explain properties of first and second order systems They can explain the dynamics of simple control loops and interpret dynamic properties in terms of frequency response and root locus They can explain the Nyquist stability criterion and the stability margins derived from it. They can explain the role of the phase margin in analysis and synthesis of control loops They can explain the way a PID controller affects a control loop in terms of its frequency response They can explain issues arising when controllers designed in continuous time domain are implemented digitally | | | |
| Skills | Students can transform models of linear dynamic systems from time to frequency domain an vice versa They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) tuning rules They can analyze and synthesize simple control loops with the help of root locus an frequency response techniques They can calculate discrete-time approximations of controllers designed in continuous-tim and use it for digital implementation They can use standard software tools (Matlab Control Toolbox, Simulink) for carrying out thes tasks | | | |
| Personal Competence | | | | |
| Social Competence | - | roups to jointly solve technical problem | s, and experin | nentally validat |
| Autonomy | their controller designs Students can obtain information from provided sources (lecture notes, software documentation experiment guides) and use it when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control their learning progress | | | |
| Workload in Hours | Independent Study Time 124, S | Study Time in Lecture 56 | | |
| Credit points | <u> </u> | | | |
| Studienleistung | <u> </u> | | | |
| | Written exam | | | |
| Examination duration and scale | | | | |



Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Bioprocess Engineering: Core qualification: Compulsory

Computer Science: Specialisation Computational Mathematics: Elective Compulsory

Electrical Engineering: Core qualification: Compulsory

Energy and Environmental Engineering: Core qualification: Compulsory

General Engineering Science (English program): Core qualification: Compulsory

Assignment for the General Englowing Curricula Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory



Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory

Mechanical Engineering: Core qualification: Compulsory

Mechatronics: Core qualification: Compulsory

Technomathematics: Specialisation III. Engineering Science: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course Core Studies: Elective

Compulsory

Process Engineering: Core qualification: Compulsory

| Course L0654: Introduct | ion to Control Systems |
|-------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. Herbert Werner |
| Language | DE |
| Cycle | WiSe |
| Content | Signals and systems Linear systems, differential equations and transfer functions First and second order systems, poles and zeros, impulse and step response Stability Feedback systems Principle of feedback, open-loop versus closed-loop control Reference tracking and disturbance rejection Types of feedback, PID control System type and steady-state error, error constants Internal model principle Root locus techniques Root locus design of PID controllers Frequency response techniques Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control Time delay systems Root locus and frequency response of time delay systems Smith predictor Digital control |
| | Sampled-data systems, difference equations Tustin approximation, digital implementation of PID controllers |
| | Software tools |
| | Introduction to Matlab, Simulink, Control toolbox Computer-based exercises throughout the course |
| Literature | Werner, H., Lecture Notes "Introduction to Control Systems" G.F. Franklin, J.D. Powell and A. Emami-Naeini "Feedback Control of Dynamic Systems' Addison Wesley, Reading, MA, 2009 K. Ogata "Modern Control Engineering", Fourth Edition, Prentice Hall, Upper Saddle River, NJ 2010 R.C. Dorf and R.H. Bishop, "Modern Control Systems", Addison Wesley, Reading, MA 2010 |



| Course L0655: Introduct | tion to Control Systems |
|-------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Herbert Werner |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| | vironmental Technolog | | | | |
|--|---|----------------------|---------------------------|-----------|----------|
| Courses | | | | | |
| Title | | | yp | Hrs/wk | CP |
| Practical Exercise Environm Environmental Technologie | , , , , , , , , , , , , , , , , , , | | ractical Course ecture | 1 2 | 1 2 |
| Module Responsible | Dr. Joachim Gerth | | | | |
| Admission Requirements | INone | | | | |
| Recommended Previous Knowledge | Fundamentals of inorganic/organic chemistry and biology | | | | |
| Educational Objectives | After taking part successfully, stu | idents have reached | the following learning | g results | |
| Professional Competence | | | | | |
| Knowledge | With the completion of this modul the students obtain profound knowledge of environmenta technology. They are able to describe the behaviour of chemicals in the environment. Students car give an overview of scientific disciplines involved. They can explain terms and allocate them to related methods. | | | | |
| Skills | Students are able to propose appropriate management and mitigation measures for environmental problems. They are able to determine geochemical parameters and to assess the potential of pollutants to migrate and transform. The students are able to work out well founded opinions on how Environmental Technology contributes to sustainable development, and they can present and defend these opinions in front of and against the group. | | | | |
| Personal Competence | | | | | |
| Social Competence | The students are able to discuss the various technical and scientific tasks, both subject-specific an multidisciplinary. They are able to develop different approaches to the task as a group as well as t discuss their theoretical or practical implementation. | | | | |
| Autonomy | Students can independently exploit sources about of the subject, acquire the particular knowledge ar tranfer it to new problems. | | | | |
| Workload in Hours | Independent Study Time 48, Stu | dy Time in Lecture 4 | 2 | | |
| Credit points | 3 | | | | |
| Studienleistung | I Vac Nona , | | Description and | | |
| | <u>'</u> | | | | |
| | Written exam | iodi Work | | | |
| Examination Examination duration and scale | Written exam | | and On the Paris | - | Facility |



General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Elective Compulsory
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Elective Compulsory
Process Engineering: Core qualification: Elective Compulsory

| Course L1387: Practical | Exercise Environmental Technology | |
|-------------------------|--|--|
| Тур | Practical Course | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | turer Dr. Joachim Gerth | |
| Language | DE | |
| Cycle | SoSe | |
| Content | The experiment demonstrates the effect of ionic strength on the binding of dissolved zinc and phosphate by soil surfaces. From the results it can be inferred that the potential of soil surfaces is modified by the application of salt. This has consequences for the retention of nutrients and pollutants. The experiment is carried out with iron oxide rich soil material. Within the lab course students discuss the various technical and scientific tasks, both subject-specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or practical implementation. | |
| Literature | F. Scheffer und P. Schachtschabel (2002): "Lehrbuch der Bodenkunde" TUB Signatur AGG-308 W.E.H. Blum (2007): "Bodenkunde in Stichworten" TUB Signatur AGG-317 C. A. J. Appelo; D. Postma (2005): "Geochemistry, groundwater and pollution" TUB Signatur GWC-515 | |

| Course L0326: Environn | nental Technologie | |
|------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | ndependent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Dr. Joachim Gerth, Prof. Martin Kaltschmitt, Prof. Kerstin Kuchta | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Introductory seminar on environmental science: Environmental impact and adverse effects Wastewater technology Air pollution control Noise protection Waste and recycling management Soil and ground water protection Renewable energies Resource conservation and energy efficiency | |
| Literature | Förster, U.: Umweltschutztechnik; 2012; Springer Berlin (Verlag) 8., Aufl. 2012; 978-3-642-22972-5 (ISBN) | |



| Module M0539: Pro | ocess and Plant Engir | neering I | | | |
|--|--|--|--|--|---|
| Courses | | | | | |
| Title Process and Plant Engineer Process and Plant Engineer Process and Plant Engineer | ing I (L0096) | | Typ Lecture Recitation Section (large) Recitation Section (small) | Hrs/wk 2 1 | CP 2 2 2 |
| Module Responsible | Prof. Georg Fieg | | | | |
| Admission Requirements | | | | | |
| Recommended Previous Knowledge | unit operation of thermal an dmechanical separation processes | | | | |
| Educational Objectives | After taking part successfully, | students have reache | ed the following learning | results | |
| Professional Competence | | | | | |
| Knowledge | students can: classify and formulate blobal balance equations of chemical processes specify linear component equations of complex chemical processes explain linear regression and data reconcilliation problems explain pfd-diagrams students are capable of | | | | |
| Skills | formulation of mass and energy balance equations and estimation of product streams estimation of component streams of chemical plants using linear component balance models solution of data reconcilliation tasks conduction of process synthesis economic evaluation of processes and the estimation of production costs | | | | |
| Personal Competence | | | | | |
| Social Competence | | | | | |
| Autonomy | | | | | |
| | Independent Study Time 124, | Study Time in Lectur | re 56 | | |
| Credit points | | rm | Description | | |
| Studienleistung | Yes 10 % | bject theoretical actical work | and | | |
| Examination | Written exam | | | | |
| Examination duration and scale | 120 Min. lectures notes and b | ooks | | | |
| Assignment for the Following Curricula | General Engineering Science General Engineering Science General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science Enviromental Engineering: Core General Engineering Science General Engineering Science | e (German program): 9 e (German program, 7 e (German program, 7 e (German program, 7 e (German program): 9 e qualification: Compute (English program): 9 | Specialisation Bioproces 7 semester): Specialisation semester): Specialisation ram, 7 semester): Specialisation bioprocess | s Engineerination Proces on Bioproces oecialisation s Engineerin | g: Compulsor s Engineering s Engineering Energy and g: Compulsory |



General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Elective Compulsory

Process Engineering: Core qualification: Compulsory

| rse L0095: Process | and Plant Engineering I |
|--------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| | Independent Study Time 32, Study Time in Lecture 28 |
| | Prof. Georg Fieg |
| Language Cycle | |
| Content | 1. Introduction Structure and operation of production plants Operational business process Technical process design Motivation and targets of process development Life cycle of production plants 2. Engineering methods and tools Mass and energy balances Strategies of process synthesis Graphical representation of processes Multidimensional regression Data reconciliation and data validation 3. Process Synthesis Decision levels Experimental process development Reactor synthesis Synthesis of separation processes (process alternatives and criteria for selection) Integration of reaction systems/separation systems (interactions, recycle streams) 4. Process safety 5. Cost estimation of production plants Production costs, capital costs, economic evaluation |
| | S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679 H. Becker, S. Godorr, H. Kreis, Chemical Engineering, January 2001, S. 68-74 Behr, W. Ebbers, N. Wiese, ChemIngTech. 72(2000)Nr. 10, S.1157 E. Blass, Entwicklung verfahrenstechnischer Prozesse, Springer-Verlag, 2. Auflage 1997 M. H. Bauer, J. Stichlmair, ChemIngTech., 68(1996), Nr. 8, 911-916 R. Dittmeyer, W. Keim, G. Kreysa, A. Oberholz, Chemische Technik. Prozesse und Produkte, Band 2, Neue Technologien, 5. Auflage, Wiley-VCH GmbH&Co.KGaA, Weinheim, 2004 J.M. Douglas, Conceptual Design of Chemical Processes, Mc Graw-Hill, NY, 1988 G. Fieg, Inz. Chem. Proc., 5(1979), S.15-19 G. Fieg, G. Wozny, L. Jeromin, Chem. Eng. Technol. 17(1994),5, 301-306 G. Fieg, Heat and Mass Transfer 32(1996), S. 205-213 G. Fieg, Chem. Eng. Processing, Vol. 41/2(2001), S. 123-133 |



| U.H. Felcht, Chemie eine reife Industrie oder weiterhin Innovationsmotor, Universitätsbuchhandlung Blazek und Bergamann, Frankfurt, 2000 | ı |
|---|---|
| J.P. van Gigch, Systems Design, Modeling and Metamodeling, Plenum Press, New York, 1991 | |

Literature

- T.F. Edgar, D.M. Himmelblau, L.S. Lasdon, Optimization of Chemical Processes, McGraw-Hill, 2001
- G. Gruhn, Vorlesungsmanuskript "Prozess- und Anlagentechnik, TU Hamburg-Harburg
- D. Hairston, Chemical Engineering, October 2001, S. 31-37
- J.L.A. Koolen, Design of Simple and Robust Process Plants, Wiley-VCH, Weinheim, 2002
- J. Krekel, G. Siekmann, Chem. -Ing.-Tech. 57(1985)Nr. 6, S. 511
- K. Machej, G. Fieg, J. Wojcik, Inz. Chem. Proc., 2(1981), S.815-824
- S. Meier, G. Kaibel, Chem. -Ing.-Tech. 62(1990)Nr. 13, S.169
- J. Mittelstraß, Chem. -Ing.-Tech. 66(1994), S. 309
- P. Li, M. Flender, K. Löwe, G. Wozny, G. Fieg, Fett/Lipid 100(1998), Nr. 12, S. 528-534
- G. Kaibel, Dissertation, TU München, 1987
- G. Kaibel, Chem.-Ing.-Tech. 61 (1989), Nr. 2, S. 104-112
- G. Kaibel, Chem. Eng. Technol., 10(1987), Nr. 2, S. 92-98
- H.J. Lang, Chem. Eng. 54(10),117, 1947
- H.J. Lang, Chem. Eng. 55(6), 112, 1948
- F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76

| Course L0096: Process and Plant Engineering I | |
|---|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Georg Fieg |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L1214: Process and Plant Engineering I | |
|---|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Georg Fieg |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Particle Technology I (L0435) | the following learning re able to ions of solids processing steps for solids processing steps by with other students or roup. | engineering, properties og according | |
|--|--|---|---|
| Particle Technology I (L0435) Reverticle Technology I (L0440) Professional Requirements Recommended Previous Knowledge Educational Objectives After taking part successfully, students have reached Previous Knowledge Educational Objectives After taking part successfully, students have reached Previous Knowledge After successful completion of the module students at a name and explain processes and unit-operated characterize particles, particle distributions are characterize particles, particle distributions are characterize particles. Skills Students are able to Accompetence Social Competence Autonomy Students are able to discuss scientific topics or all develop solutions for technical-scientific issues in a geometry Students are able to analyze and solve questions regulated to the product and solve questions regulated to analyze and solve questions regulated to analyze and solve questions regulated to analyze and solve questions regulated to the product and product a | ecitation Section (small) actical Course the following learning re able to ions of solids process and to discuss their bulk personal solids processing steps ly with other students or roup. | results regulates results results results results | to the desired |
| Particle Technology I (L0440) Module Responsible Prof. Stefan Heinrich Admission Requirements None Recommended Previous Knowledge Educational Objectives After taking part successfully, students have reached Professional Competence After successful completion of the module students at | the following learning re able to ions of solids process and to discuss their bulk pees for solids processing steps solids processing steps by with other students or roup. | results engineering, properties or scientific pe | to the desired |
| Module Responsible Prof. Stefan Heinrich Admission Requirements None | re able to ions of solids process end to discuss their bulk part to discuss their bulk part to discuss for solids processing steps along the solids processing steps by with other students or roup. | engineering, properties og according | |
| Admission Requirements Recommended Previous Knowledge Educational Objectives After taking part successfully, students have reached Professional Competence After successful completion of the module students at a name and explain processes and unit-operat characterize particles, particle distributions are characterize particles, particle distributions are characterize particles, particle distributions are solids properties of the product asses solids with respect to their behavior in a document their work scientifically. Personal Competence Social Competence Autonomy Workload in Hours Credit points Compulsory Bonus Examination duration and scale General Engineering Science (German program): Specience Ingineering Science (German p | re able to ions of solids process end to discuss their bulk part to discuss their bulk part to discuss for solids processing steps along the solids processing steps by with other students or roup. | engineering, properties og according | |
| Recommended Previous Knowledge Keine | re able to ions of solids process end to discuss their bulk part to discuss their bulk part to discuss for solids processing steps along the solids processing steps by with other students or roup. | engineering, properties og according | |
| Previous Knowledge Educational Objectives After taking part successfully, students have reached Professional Competence After successful completion of the module students at • name and explain processes and unit-operat • characterize particles, particle distributions ar • name and explain processes and unit-operat • characterize particles, particle distributions ar • characterize particles, particle distributions ar • choose and design apparatuses and process solids properties of the product • asses solids with respect to their behavior in s • document their work scientific ally. Personal Competence The students are able to discuss scientific topics oral develop solutions for technical-scientific issues in a g Students are able to analyze and solve questions reg Students are able to analyze and solve questions reg Workload in Hours Independent Study Time 110, Study Time in Lecture Compulsory Bonus Form Yes None Written elaboration Examination duration and scale 90 minutes General Engineering Science (German program): Sp General Engineering Science (Germa | re able to ions of solids process end to discuss their bulk part to discuss their bulk part to discuss for solids processing steps along the solids processing steps by with other students or roup. | engineering, properties og according | |
| Professional Competence After successful completion of the module students at • name and explain processes and unit-operat • characterize particles, particle distributions ar Students are able to • choose and design apparatuses and process solids properties of the product • asses solids with respect to their behavior in second develop solutions for technical-scientific topics oral develop solutions for technical-scientific issues in a geometric study and solve questions regulated to analyze | re able to ions of solids process end to discuss their bulk part to discuss their bulk part to discuss for solids processing steps along the solids processing steps by with other students or roup. | engineering, properties og according | |
| After successful completion of the module students at • name and explain processes and unit-operat • characterize particles, particle distributions ar Students are able to • choose and design apparatuses and process solids properties of the product • asses solids with respect to their behavior in second develop solutions for technical-scientific issues in a general Engineering Science (German program): Specience (Ge | ions of solids process of to discuss their bulk part to discuss the solids processing steps also with other students of the part to discuss the solids processing steps aroup. | properties g according or scientific pe | |
| After successful completion of the module students at name and explain processes and unit-operat characterize particles, particle distributions ar Students are able to choose and design apparatuses and process solids properties of the product asses solids with respect to their behavior in second develop solutions for technical-scientific issues in a general Engineering Science (German program): Specience (German pro | ions of solids process of to discuss their bulk part to discuss the solids processing steps also with other students of the part to discuss the solids processing steps aroup. | properties g according or scientific pe | |
| ** name and explain processes and unit-operat | ions of solids process of to discuss their bulk part to discuss the solids processing steps also with other students of the part to discuss the solids processing steps aroup. | properties g according or scientific pe | |
| Skills • choose and design apparatuses and process solids properties of the product • asses solids with respect to their behavior in solid development their work scientifically. Personal Competence Social Competence Autonomy The students are able to discuss scientific topics or all development solutions for technical-scientific issues in a great great point of the students are able to analyze and solve questions regreated by the solution of the study of the solution of the solution of the study of the solution of th | solids processing steps ly with other students or | or scientific pe | |
| Social Competence Autonomy The students are able to discuss scientific topics oral develop solutions for technical-scientific issues in a general Engineering Science (German program): Sp. Genera | roup. | · | ersonal and t |
| Social Competence develop solutions for technical-scientific issues in a general Engineering Science (German program): Sp. General Engineering | roup. | · | ersonal and t |
| Workload in Hours Independent Study Time 110, Study Time in Lecture Credit points 6 Compulsory Bonus Form Yes None Written elaboration Examination Written exam Examination duration and scale General Engineering Science (German program): Sp General Engineering Science (German program) | arding solid particles in | ndependently | |
| Credit points 6 Studienleistung Yes None Written elaboration Examination Written exam Examination duration and scale General Engineering Science (German program): Sp General Enginee | , | | y. |
| Studienleistung Yes None Written elaboration Examination Written exam Examination duration and scale General Engineering Science (German program): Sp General Engineering Science (Ge | 70 | | |
| Studienleistung Yes None Written elaboration Examination Written exam Examination duration and scale General Engineering Science (German program): Sp General Engineering Science (Ge | | | |
| Examination Written exam Examination duration and scale General Engineering Science (German program): Sp General Engineering: Compulsory | Description | | |
| Examination duration and scale General Engineering Science (German program): Sp General Engineering Science (German program): Sp General Engineering Science (German program Engineering: Compulsory | sechs Berichte (p 5-10 Seiten | oro Versuch | ein Bericht) a |
| Examination duration and scale General Engineering Science (German program): Sp General Engineering Science (German program): Sp General Engineering Science (German program Engineering: Compulsory | 2 . 0 00.1011 | | |
| General Engineering Science (German program): Sp General Engineering Science (German program): Sp General Engineering Science (German program Engineering: Compulsory | | | |
| General Engineering Science (German program): Sp General Engineering Science (German program Engineering: Compulsory | | | |
| Compulsory General Engineering Science (German program, 7 s Compulsory General Engineering Science (German program Environmental Engineering: Compulsory Bioprocess Engineering: Core qualification: Compuls Energy and Environmental Engineering: Core qualific General Engineering Science (English program): Specific General Engineering: Compulsory General Engineering Science (English program): Specific General Engineering S | m): Specialisation En semester): Specialisation emester): Specialisation m, 7 semester): Specialisation sory cation: Compulsory | nergy and tion Process n Bioprocess ecialisation Engineering nergy and | Enviromental Engineering Engineering Energy and Compulsory Enviromental |



General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory
General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory
Process Engineering: Core qualification: Compulsory

| Course L0434: Particle Technology I | | | |
|-------------------------------------|---|--|--|
| Тур | Typ Lecture | | |
| Hrs/wk 2 | | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Stefan Heinrich | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Description of particles and particle distributions Description of a separation process Description of a particle mixture Particle size reduction Agglomeration, particle size enlargement Storage and flow of bulk solids Basics of fluid/particle flows classifying processes Separation of particles from fluids Basic fluid mechanics of fluidized beds Pneumatic and hydraulic transport | | |
| Literature | Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992. | | |

| Course L0435: Particle Technology I | |
|-------------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Stefan Heinrich |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |



| Course L0440: Particle Technology I | | |
|-------------------------------------|---|--|
| Тур | Practical Course | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer Prof. Stefan Heinrich | | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | Sieving Bulk properties Size reduction Mixing Gas cyclone Blaine-test, filtration Sedimentation | |
| Literature | Schubert, H.; Heidenreich, E.; Liepe, F.; Neeße, T.: Mechanische Verfahrenstechnik. Deutscher Verlag für die Grundstoffindustrie, Leipzig, 1990. Stieß, M.: Mechanische Verfahrenstechnik I und II. Springer Verlag, Berlin, 1992. | |



| Module M0829: Foundations of Management | | | | |
|--|---|--|---|--|
| Courses | | | | |
| Title Management Tutorial (L088) Introduction to Management | • | Typ Recitation Section (large) Lecture | Hrs/wk 2 3 | CP 3 3 |
| Module Responsible | 1 | | | |
| Admission Requirements | | | | |
| Recommended Previous Knowledge | I Racic Knowiadda at Wathamatice and Rijeina | ss | | |
| Educational Objectives | After taking part successfully, students have re | eached the following learning | results | |
| Professional Competence | | | | |
| | After taking this module, students know the ir Management, from Planning and Organisation and Controlling. In particular they are able to | on to Marketing and Innovati | on, and als | o to Investmer |
| Knowledge | explain the differences between Economic Management and to name important differences of explain the most important aspects of aspects of entreprneurial projects describe and explain basic business supply chain management, organized management, innovation management explain the relevance of planning and multiple objectives and uncertainty, Finance state basics from accounting and costing | efinitions from the field of Mar and goals in Management ar s functions as production, p tion and human ressource t and marketing d decision making in Busine and explain some basic m | nagement and name the procurement management ss, esp. in sethods from | most importar t and sourcing ent, informatio |
| Skills | Students are able to analyse business units of strategies etc.) and to carry out an Entreprene analyse Management goals and struct analyse organisational and staff struct apply methods for decision making une analyse production and procurement s analyse and apply basic methods of m select and apply basic methods from m apply basic methods from accounting, | urship project in a team. In pa ure them appropriately ures of companies der multiple objectives, under systems and Business informa arketing nathematical finance to prede | uncertainty ation system | y are able to and under risk s |
| Personal Competence | | | | |
| Social Competence | work successfully in a team of students to apply their knowledge from the lect report on the project to communicate appropriately and to cooperate respectfully with their fello | ure to an entrepreneurship p | project and v | write a coherer |
| Autonomy | Students are able to work in a team and to organize the tea to write a report on their project. | m themselves | | |
| | Independent Study Time 110, Study Time in L | ecture 70 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| | Subject theoretical and practical work | | | |
| Examination duration | Examination duration | | | |



and scale several written exams during the semester

General Engineering Science (German program): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program): Specialisation Computer Science: Compulsory General Engineering Science (German program): Specialisation Process Engineering: Compulsory General Engineering Science (German program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (German program): Specialisation Mechanical Engineering: Compulsory

General Engineering Science (German program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory

Civil- and Environmental Engineering: Core qualification: Compulsory

Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory

Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory

Assignment for the Following Curricula

General Engineering Science (English program): Specialisation Civil- and Environmental Engeneering: Compulsory

General Engineering Science (English program): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program): Specialisation Computer Science: Compulsory General Engineering Science (English program): Specialisation Mechanical Engineering: Compulsory General Engineering Science (English program): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program): Specialisation Naval Architecture: Compulsory General Engineering Science (English program): Specialisation Process Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Naval Architecture:



Compulsory

General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering Sciences: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development and Production: Compulsory

General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering,

Focus Energy Systems: Compulsory

Computational Science and Engineering: Core qualification: Compulsory Computational Science and Engineering: Core qualification: Compulsory

Logistics and Mobility: Core qualification: Compulsory Mechanical Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory

Naval Architecture: Core qualification: Compulsory Technomathematics: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory

| Course L0882: Management Tutorial | | | |
|-----------------------------------|--|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Christoph Ihl, Katharina Roedelius, Tobias Vlcek | | |
| Language | DE | | |
| Cycle | WiSe/SoSe | | |
| Content | In the management tutorial, the contents of the lecture will be deepened by practical examples and the application of the discussed tools. If there is adequate demand, a problem-oriented tutorial will be offered in parallel, which students can choose alternatively. Here, students work in groups on self-selected projects that focus on the elaboration of an innovative business idea from the point of view of an established company or a startup. Again, the business knowledge from the lecture should come to practical use. The group projects are guided by a mentor. | | |
| Literature | Relevante Literatur aus der korrespondierenden Vorlesung. | | |



| urse L0880: Introduction to Management | | | |
|--|--|--|--|
| | Lecture | | |
| Hrs/wk | 3 | | |
| СР | 3 | | |
| Workload in Hours | dependent Study Time 48, Study Time in Lecture 42 | | |
| Lecturer | Fischer, Prof. Cornelius Herstatt, Prof. Wolfgang Kersten, Prof. Matthias Meyer, Prof. Thomas Wrona | | |
| Language | | | |
| Cycle | WiSe/SoSe | | |
| Content | Introduction to Business and Management, Business versus Economics, relevant areas i Business and Management Important definitions from Management, Developing Objectives for Business, and their relation to important Business functions Business Functions: Functions of the Value Chain, e.g. Production and Procurement, Suppl Chain Management, Innovation Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Information Management Definitions as information, information systems, aspects of data security and strategic information systems Definition and Relevance of innovations, e.g. innovation opportunities, risks etc. Relevance of marketing, B2B vs. B2C-Marketing different techniques from the field of marketing (e.g. scenario technique), pricing strategies important organizational structures basics of human ressource management Introduction to Business Planning and the steps of a planning process Decision Analysis: Elements of decision problems and methods for solving decision problems Selected Planning Tasks, e.g. Investment and Financial Decisions Introduction to Accounting: Accounting, Balance-Sheets, Costing Relevance of Controlling and selected Controlling methods Important aspects of Entrepreneurship projects | | |
| Literature | Bamberg, G., Coenenberg, A.: Betriebswirtschaftliche Entscheidungslehre, 14. Aufl., München 2008 Eisenführ, F., Weber, M.: Rationales Entscheiden, 4. Aufl., Berlin et al. 2003 Heinhold, M.: Buchführung in Fallbeispielen, 10. Aufl., Stuttgart 2006. Kruschwitz, L.: Finanzmathematik. 3. Auflage, München 2001. Pellens, B., Fülbier, R. U., Gassen, J., Sellhorn, T.: Internationale Rechnungslegung, 7. Aufl., Stuttga 2008. Schweitzer, M.: Planung und Steuerung, in: Bea/Friedl/Schweitzer: Allgemein Betriebswirtschaftslehre, Bd. 2: Führung, 9. Aufl., Stuttgart 2005. Weber, J., Schäffer, U.: Einführung in das Controlling, 12. Auflage, Stuttgart 2008. Weber, J./Weißenberger, B.: Einführung in das Rechnungswesen, 7. Auflage, Stuttgart 2006. | | |



| Module M0891: Inf | ormatics for Process Engineers | | | |
|--|--|--|--|--|
| | | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Informatics for Process Eng Informatics for Process Eng | | Lecture Recitation Section (small) | 2 | 2 |
| Numeric and Matlab (L0125) | | Practical Course | 2 | 2 |
| Module Responsible | Dr. Marcus Venzke | | | |
| Admission Requirements | | | | |
| Recommended Basic knowledge in using MS Windows. Previous Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have read | ched the following learning | results | |
| Professional Competence | Professional | | | |
| Knowledge | | | | |
| | Students are capable of object-oriented progran mathematic questions by using Matlab. | nming in the programing la | nguage Jav | a and of solving |
| Skills | Students are capable of developing concepts (s | mple algorithms) to solve te | echnical que | estions. |
| Personal Competence Students are able to work out solutions together in small groups. Social Competence | | | | |
| Autonomy | Autonomy Students are able to assess acquired skills by applying it in practice. | | | |
| Workload in Hours Independent Study Time 96, Study Time in Lecture 84 | | | | |
| Credit points | 6 | | | |
| Studienleistung | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 90 min | | | |
| Assignment for the Following Curricula | General Engineering Science (German prog Compulsory General Engineering Science (German pr Enviromental Engineering: Elective Compulsory General Engineering Science (German progra Elective Compulsory Bioprocess Engineering: Core qualification: Cor Energy and Environmental Engineering: Core q General Engineering Science (English prog Compulsory General Engineering Science (English program Engineering: Elective Compulsory General Engineering Science (English progra Elective Compulsory Process Engineering: Core qualification: Compu | ogram, 7 semester): Specialisann pulsory pulsory pulsory pramition of the process | pecialisation ation Proces ess Engine n Energy ar | n Energy and ss Engineering: eering: Elective and Enviromental |



| ourse L0836: Informatics for Process Engineers | | |
|--|---|--|
| Тур | Typ Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Dr. Marcus Venzke | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Introduction to object-oriented modelling and programming exemplified with Java Objects, classes Methods, properties Inheritance Basics of the language Java Sample application: Simulation of an electricity network 2D graphics Events and Controls | |
| Literature | Campione, Mary; Walrath, Kathy: The Java Tutorial - A practical guide for programmers. Addison-Wesley, Reading, Massachusets, 1998. Bibliothek: TII 978 Krüger, Guido; Hansen, Heiko: Handbuch der Java-Programmierung. 3. Auflage Addison-Wesley, 2002. http://www.javabuch.de/ Krüger, Guido: Go to Java 2. Addison-Wesley Verlag, Bonn, 1999. Bibliothek: TII 717 Cowell, John: Essential Java 2 fast. Springer Verlag, London, 1999. Bibliothek: TII 942 Java SE 7 Documentation http://docs.oracle.com/javase/7/docs/ Java Platform, Standard Edition 7 API Specification http://docs.oracle.com/javase/7/docs/api/ | |



| ourse L0837: Informati | cs for Process Engineers |
|------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Marcus Venzke |
| Language | DE |
| Cycle | SoSe |
| Content | In the lab, the content from the lecture is practiced and deepened with practical assignments. Every week one or two programming tasks are assigned. These are solved by the students on computers independently, coached by a tutor. |
| Literature | Campione, Mary; Walrath, Kathy: The Java Tutorial - A practical guide for programmers. Addison-Wesley, Reading, Massachusets, 1998. Bibliothek: TII 978 Krüger, Guido; Hansen, Heiko: Handbuch der Java-Programmierung. 3. Auflage Addison-Wesley, 2002. http://www.javabuch.de/ Krüger, Guido: Go to Java 2. Addison-Wesley Verlag, Bonn, 1999. Bibliothek: TII 717 Cowell, John: Essential Java 2 fast. Springer Verlag, London, 1999. Bibliothek: TII 942 Java SE 7 Documentation http://docs.oracle.com/javase/7/docs/ Java Platform, Standard Edition 7 API Specification http://docs.oracle.com/javase/7/docs/api/ |

| Course L0125: Numeric and Matlab | |
|----------------------------------|--|
| Тур | Practical Course |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Siegfried Rump, Weitere Mitarbeiter |
| Language | DE |
| Cycle | SoSe |
| Content | Programming in Matlab Numerical methods for systems of nonlinear equations Basics in computer arithmetic Linear and nonlinear optimization Condition of problems and algorithms Verified numerical results with INTLAB |
| Literature | Literatur (Software-Teil): 1. Moler, C., Numerical Computing with MATLAB, SIAM, 2004 2. The Math Works, Inc., MATLAB: The Language of Technical Computing, 2007 3. Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de 4. Highham, D. J.; Highham, N. J., MATLAB Guide, SIAM, 2005 |



| | vironmental Technology | | | |
|--|--|--|---|---|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Environmental Assessment Environmental Assessment | | Lecture Recitation Section (small) | 2 1 | 2 1 |
| Module Responsible | Prof. Martin Kaltschmitt | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Fundamentals of inorganic/organic chemistry | and biology | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning | results | |
| Professional Competence | | | | |
| Knowledge | With the completion of this module the students acquire in-depth knowledge of important cause-effect chains of potential environmental problems which might occur from production processes, projects of construction measures. They have knowledge about the methodological diversity and are competent in dealing with different methods and instruments to assess environmental impacts. Besides the students are able to estimate the complexity of these environmental processes as well as uncertainties and difficulties with their measurement. | | | |
| Skills | The students are able to select a suitable method for the respective case from the variety of assessment methods. Thereby they can develop suitable solutions for managing and mitigating environmental problems in a business context. They are able to carry out Life Cycle Impact Assessments independently and can apply the software programs OpenLCA and the database Ecolorent. After finishing the course the students have the competence to critically judge research results or other publications on environmental impacts. | | | |
| Personal Competence | | | | |
| Social Competence | The students are able to discuss the various technical and scientific tasks, both subject-specific an multidisciplinary. They are able to develop jointly different solutions and to discuss their theoretical operactical implementation. Due to the selected lecture topics, the students receive insights into the multi-layered issues of the environment protection and the concept of sustainability. Their sensitivity | | | |
| Autonomy | The students learn to research, process and present a scientific topic independently. They are able to carry out independent scientific work. They can solve an environmental problem in a business context, and are able to judge results of other publications. | | | |
| Workload in Hours | Independent Study Time 48, Study Time in L | ecture 42 | | |
| Credit points | | | | |
| Studienleistung | | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 1 hour written exam | | | |
| | General Engineering Science (German Engineering: Compulsory General Engineering Science (German programmental Engineering Science (German Environmental Engineering: Compulsory General Engineering Science (German programmental Engineering Sc | program): Specialisation Proc program, 7 semester): Specialisation gram, 7 semester): Specialisation | ess Engine pecialisation ation Proces | eering: Electiv n Energy and ss Engineering |



| Assignment for the | Energy and Environmental Engineering: Core qualification: Compulsory | | |
|---------------------|--|--|--|
| Following Curricula | General Engineering Science (English program): Specialisation Energy and Environmental | | |
| | Engineering: Compulsory | | |
| | General Engineering Science (English program): Specialisation Process Engineering: Elective | | |
| | Compulsory | | |
| | General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromen | | |
| | Engineering: Compulsory | | |
| | General Engineering Science (English program, 7 semester): Specialisation Process Engineering: | | |
| | Elective Compulsory | | |
| | General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering | | |
| | Elective Compulsory | | |
| | Process Engineering: Core qualification: Elective Compulsory | | |
| | Process Engineering: Core qualification: Compulsory | | |

| Course L0860: Environn | nental Assessment |
|------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Anne Rödl, Dr. Christoph Hagen Balzer |
| Language | DE/EN |
| Cycle | SoSe |
| Content | Contaminants: Impact- and Risk Assessment Environmental damage & precautionary principle: Environmental Risk Assessment (ERA) Resource and water consumption: Material flow analysis Energy consumption: Cumulated energy demand (CED), cost analysis Life cycle concept: Life cycle assessment (LCA) Sustainability: Comprehensive product system assessment, SEE-Balance Management: Environmental and Sustainability management (EMAS) Complex systems: MCDA and scenario method |
| Literature | Foliensätze der Vorlesung Studie: Instrumente zur Nachhaltigkeitsbewertung - Eine Synopse (Forschungszentrum Jülich GmbH) |



| Course L1054: Environmental Assessment | | |
|--|--|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Martin Kaltschmitt | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Presentation and application of free software programs in order to understand the concepts of environmental assessment methods better. Within the group exercise students discuss the various technical and scientific tasks, both subject- | |
| Content | specific and multidisciplinary. They discuss different approaches to the task as well as it's theoretical or practical implementation. | |
| Literature | Power point Präsentationen | |



Thesis

| Courses | | | |
|-----------------------------------|---|--|----|
| Γitle | Тур | Hrs/wk | СР |
| Module Responsible | Professoren der TUHH | | |
| Admission Requirements | According to General Regulations §21 (1): | | |
| Recommended Previous Knowledge | | | |
| | After taking part successfully, students have reached the following lear | nina results | |
| Professional Competence | | | |
| Knowledge | The students can select, outline and, if need be, critically discuss the most important scientifundamentals of their course of study (facts, theories, and methods). On the basis of their fundamental knowledge of their subject the students are capable relation to a specific issue of opening up and establishing links with extended specialize expertise. The students are able to outline the state of research on a selected issue in their subject area | | |
| Skills | acquired in their studies to solve subject-related problems. With the aid of the methods they have learnt during their st problems, make decisions on technical issues, and develop so | With the aid of the methods they have learnt during their studies the students can analy roblems, make decisions on technical issues, and develop solutions. he students can take up a critical position on the findings of their own research work from | |
| Personal Competence | | | |
| Social Competence | Both in writing and orally the students can outline a scientif accurately, understandably and in a structured way. The students can deal with issues in an expert discussion and appropriate to the addressees. In doing so they can upho viewpoints convincingly. | ructured way. n expert discussion and answer them in a manner that | |
| Autonomy | The students are capable of structuring an extensive work process in terms of time and dealing with an issue within a specified time frame. The students are able to identify, open up, and connect knowledge and material necessary working on a scientific problem. The students can apply the essential techniques of scientific work to research of their own. | | |
| Workload in Hours | Independent Study Time 360, Study Time in Lecture 0 | | |
| Credit points | 12 | | |
| Studienleistung | None | | |
| Examination | Thesis | | |
| Examination duration | | | |



General Engineering Science (German program, 7 semester): Thesis: Compulsory

Civil- and Environmental Engineering: Thesis: Compulsory

Bioprocess Engineering: Thesis: Compulsory Computer Science: Thesis: Compulsory Electrical Engineering: Thesis: Compulsory

Energy and Environmental Engineering: Thesis: Compulsory General Engineering Science (English program): Thesis: Compulsory

General Engineering Science (English program, 7 semester): Thesis: Compulsory

Computational Science and Engineering: Thesis: Compulsory Computational Science and Engineering: Thesis: Compulsory

Logistics and Mobility: Thesis: Compulsory Mechanical Engineering: Thesis: Compulsory

Mechatronics: Thesis: Compulsory Naval Architecture: Thesis: Compulsory Technomathematics: Thesis: Compulsory

xx: Thesis: Compulsory

Assignment for the

Following Curricula

Process Engineering: Thesis: Compulsory