

Module Manual

Bachelor of Science (B.Sc.)

General Engineering Science (German program, 7 semester)

Cohort: Winter Term 2019 Updated: 24th May 2022

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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 Responsible | Dagmar Richter |
|-----------------------------|---|
| • | None |
| Recommended Previous | None |
| Knowledge | 1 |
| - | After taking part successfully, students have reached the following learning results |
| Professional Competence | |
| Knowledge | 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 fu Self-reliance, self-management, collaboration and professional and personnel management competences. The departm implements these training objectives in its teaching architecture , in its teaching and learning arrangements , in teach areas and by means of teaching offerings in which students can qualify by opting for specific competences and a compete level at the Bachelor's or Master's level. The teaching offerings are pooled in two different catalogues for nontechn complementary courses. |
| | The Learning Architecture |
| | consists of a cross-disciplinarily study offering. The centrally designed teaching offering ensures that courses in the nontechn academic programms follow the specific profiling of TUHH degree courses. |
| | The learning architecture demands and trains independent educational planning as regards the individual development 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 two semesters. In view of the adaptation problems that individuals commonly face in their first semesters after making transition from school to university and in order to encourage individually planned semesters abroad, there is no obligation 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 dea with interdisciplinarity and a variety of stages of learning in courses are part of the learning architecture and are deliberat encouraged in specific courses. |
| | Fields of Teaching |
| | are based on research findings from the academic disciplines cultural studies, social studies, arts, historical studies, migral studies, communication studies and sustainability research, and from engineering didactics. In addition, from the winter semes 2014/15 students on all Bachelor's courses will have the opportunity to learn about business management and start-ups in a groriented way. |
| | The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging go 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. Th differences are reflected in the practical examples used, in content topics that refer to different professional application conte 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 leaders 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 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 represental 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. |
| Skills | Professional Competence (Skills) |
| JKIII3 | |
| | In selected sub-areas students can |
| | apply basic methods of the said scientific disciplines, auestion a specific technical phenomena, models, theories from the viewpoint of another, aforementioned special 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 technical relationship to the subject. |

| 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. |
| Autonomy | Personal Competences (Self-reliance) Students are able in selected areas |
| | to reflect on their own profession and professionalism in the context of real-life fields of application 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: Elect | rical Engineerin | ig I: Direct C | urrent Networks | and Electromagnet | ic Fields | | |
|---------------------------------------|--------------------------|----------------------|---------------------------|-------------------------------|-----------|----|--|
| Courses | | | | | | | |
| Title | | | | Тур | Hrs/wk | СР | |
| Electrical Engineering I: Direct Curr | rent Networks and Electr | omagnetic Fields (LC | 0675) | Lecture | 3 | 5 | |
| Electrical Engineering I: Direct Curr | rent Networks and Electr | omagnetic Fields (LC |)676) | Recitation Section (small) | 2 | 1 | |
| Module Responsible | Prof. Matthias Kuhl | | | | | | |
| Admission Requirements | None | | | | | | |
| Recommended Previous | | | | | | | |
| Knowledge | | | | | | | |
| Educational Objectives | After taking part succ | essfully, students | have reached the followi | ng learning results | | | |
| Professional Competence | | | | | | | |
| Knowledge | | | | | | | |
| Skills | | | | | | | |
| Personal Competence | | | | | | | |
| Social Competence | | | | | | | |
| Autonomy | | | | | | | |
| Workload in Hours | Independent Study Ti | me 110, Study Tin | ne in Lecture 70 | | | | |
| Credit points | 6 | | | | | | |
| Course achievement | Compulsory Bonus | Form | Description | | | | |
| | No 10 % | Excercises | | | | | |
| Examination | Written exam | | | | | | |
| Examination duration and | 120 Minutes | | | | | | |
| scale | | | | | | | |
| Assignment for the | General Engineering | Science (German p | orogram, 7 semester): Co | ore Qualification: Compulsory | | | |
| Following Curricula | Electrical Engineering | g: Core Qualificatio | n: Compulsory | | | | |
| | Computational Science | e and Engineering | : Core Qualification: Com | npulsory | | | |
| | Mechatronics: Core Q | ualification: Comp | ulsory | | | | |
| | Orientierungsstudium | n: Core Qualificatio | n: Elective 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. Matthias Kuhl | | |
| 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 | | |

| Тур | Recitation Section (small) | | | |
|-------------------|--|--|--|--|
| Hrs/wk | 2 | | | |
| CP | 1 | | | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | | | |
| Lecturer | Prof. Matthias Kuhl | | | |
| Language | DE | | | |
| Cycle | WiSe | | | |
| Content | | | | |
| Literature | Übungsaufgaben zur Elektrotechnik 1, TUHH, 2013 Ch. Kautz: Tutorien zur Elektrotechnik, Pearson Studium, 2010 | | | |

| Module M0889: Mecha | anics I (Sta | tics) | | | | |
|--|---|-----------------|-------------------------------|----------------------------------|--------------------|--------------------|
| Courses | | | | | | |
| Title | | | | T | Line (colo | 67 |
| Hitle Mechanics I (Statics) (L1001) | | | | Typ Lecture | Hrs/wk 2 | CP 3 |
| Mechanics I (Statics) (L1001) Mechanics I (Statics) (L1002) | | | | Recitation Section (small) | 2 | 2 |
| Mechanics I (Statics) (L1003) | | | | Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof. Robert Sei | ifried | | | | |
| | None | | | | | |
| Recommended Previous | Solid school kn | owledge in mat | ematics and physics. | | | |
| Knowledge | 1 | | | | | |
| Educational Objectives | After taking par | t successfully, | udents have reached the fol | lowing learning results | | |
| Professional Competence | | | | | | |
| Knowledge | The students ca | an | | | | |
| | l | | | | | |
| | | | ocedure used in mechanical | contexts; | | |
| | | | n model design; | | | |
| | present t | echnical know | dge in stereostatics. | | | |
| Skills | The students ca | an | | | | |
| | explain the important elements of mathematical / mechanical analysis and model formation, and apply it to the context their own problems; explicit analysis and model formation, and apply it to the context | | | | | |
| | | | | | | y it to the contex |
| | | | | | | |
| | 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. | | | | | |
| | • estimate | the reach and | oundaries of statical method | s and extend them to be applica | ble to wider probl | em sets. |
| Personal Competence | l | | | | | |
| Social Competence | The students can work in groups and support each other to overcome 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 St | udy Time 110, | tudy Time in Lecture 70 | | | |
| Credit points | 6 | | | | | |
| Course achievement | Compulsory Bonu | | Description | | | |
| | No 20 9 | % Midteri | Wird nur | im WiSe angeboten | | |
| | | | | | | |
| | 90 min | | | | | |
| scale | | | | | | |
| - | - | - | | : Core Qualification: Compulsory | | |
| Following Curricula | | - | ering: Core Qualification: Co | mpulsory | | |
| | - | - | ualification: Compulsory | | | |
| | Mechatronics: C | | | | | |
| | - | | lification: Elective Compulso | ry | | |
| | Nous Architect | uro: Coro Ouali | cation: Compulsory | | | |

| Course L1001: Mechanics I (| statics) | | | | | |
|-----------------------------|--|--|--|--|--|--|
| Тур | Lecture | | | | | |
| Hrs/wk | | | | | | |
| CP | 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 (S | Course L1002: Mechanics I (Statics) | | | | |
|------------------------------|---|--|--|--|--|
| Тур | Recitation Section (small) | | | | |
| Hrs/wk | 2 | | | | |
| CP | 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). | | | |

| Module M0850: Math | ematics I | | | |
|-----------------------------------|---|--|--------------------|---|
| | | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Analysis I (L1010) | | Lecture | 2 | 2 |
| Analysis I (L1012) | | Recitation Section (small) | 1 | 1 |
| Analysis I (L1013) | | Recitation Section (large) | 1 | 1 |
| Linear Algebra I (L0912) | | Lecture | 2 | 2 |
| Linear Algebra I (L0913) | | Recitation Section (small) | 1 | 1 |
| Linear Algebra I (L0914) | | Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof. Anusch Taraz | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | School mathematics | | | |
| Educational Objectives | After taking part successfully, students have reached the | e following learning results | | |
| Professional Competence | Arter taking pare successivity, students have reached the | ronowing learning results | | |
| - | | | | |
| Knowledge | Students can name the basic concepts in analy | sis and linear algebra. They are abl | e to explain the | em using appropriate |
| | examples. | | | ···· ••···· • • • • • • • • • • • • • • |
| | Students can discuss logical connections between | these concepts. They are canable | of illustrating th | aca connections with |
| | | These concepts. They are capable | or muscracing th | ese connections with |
| | the help of examples. | | | |
| | They know proof strategies and can reproduce the | em. | | |
| | | | | |
| | | | | |
| Skills | | | | |
| | Students can model problems in analysis and line | ear algebra with the help of the conce | pts studied in th | nis course. Moreover |
| | they are capable of solving them by applying esta | blished methods. | | |
| | Students are able to discover and verify further lo | gical connections between the concep | ots studied in the | e course. |
| | For a given problem, the students can develop | and execute a suitable approach, a | nd are able to c | ritically evaluate the |
| | results. | | | 2 |
| | (courtor | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| | Students are able to work together in teams. They | | | |
| | In doing so, they can communicate new concepts | according to the needs of their coop | erating partners | . Moreover, they car |
| | design examples to check and deepen the unders | tanding of their peers. | | |
| | | | | |
| | | | | |
| Autonomy | | | | |
| Autonomy | Students are capable of checking their understar | nding of complex concepts on their o | wn. They can sp | ecify open questions |
| | precisely and know where to get help in solving the | nem. | | |
| | Students have developed sufficient persistence | to be able to work for longer period | s in a goal-orien | ted manner on hard |
| | problems. | | 5 | |
| | P | | | |
| | | | | |
| Workload in Hours | Independent Study Time 128, Study Time in Lecture 112 | | | |
| Credit points | 8 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 60 min (Analysis I) + 60 min (Linear Algebra I) | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 seme | ster): Core Qualification: Compulsory | | |
| Following Curricula | Civil- and Environmental Engineering: Core Qualification | | | |
| , | Bioprocess Engineering: Core Qualification: Compulsory | | | |
| | 1 5 5 1 | | | |
| | Electrical Engineering: Core Qualification: Compulsory | | | |
| | Energy and Environmental Engineering: Core Qualification | | | |
| | Computational Science and Engineering: Core Qualification | ion: Compulsory | | |
| | Logistics and Mobility: Core Qualification: Compulsory | | | |
| | Mechanical Engineering: Core Qualification: Compulsory | | | |
| | Mechatronics: Core Qualification: Compulsory | | | |
| | Orientierungsstudium: Core Qualification: Elective Comp | ulsory | | |
| | Naval Architecture: Core Qualification: Compulsory | | | |
| | | | | |
| | Process Engineering: Core Qualification: Compulsory | | | |

| Course L1010: Analysis I | | |
|--------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | | |
| 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 | 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 | ourse L1013: Analysis I | |
|--------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | 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 | al |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 | al | |
|------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| CP | 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 Algebr | urse L0914: Linear Algebra I | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| CP | 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 | | |

| Courses | | | | |
|---|---|--|--------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Physics for Engineers (L0367) | | Lecture | 2 | 3 |
| Physics for Engineers (Problem Solv | ing Course) (L0368) | Recitation Section (small) | 1 | 1 |
| Module Responsible | Prof. Manfred Eich | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Calculus and linear algebra on high so Physics on high school level | thool level | | |
| Educational Objectives | After taking part successfully, students have | reached 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. | | | |
| | Students can relate physics topics to technical problems. | | | |
| Skills | 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 pro problem solving courses. | oblems in groups. They can present their results | effectively within | the framework of t |
| Autonomy | the lecture. They can reflect their acquired | ormation from the provided references and to rud level of expertise with the help of lecture action of connect their knowledge with that acquired from | companying mea | |
| Workload in Hours | Independent Study Time 78, Study Time in L | ecture 42 | | |
| Credit points | 4 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 120 min | | | |
| Assignment for the Following Curricula | General Engineering Science (German progr | am, 7 semester): Core Qualification: Compulsory | 1 | |

| Course L0367: Physics for Engineers | | |
|-------------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| CP | | |
| 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, <i>Fundamentals of physics</i>, Wiley K. Cummings, P. Laws, E. Redish, and P. Cooney ("CLRC"), <i>Understanding Physics</i>, Wiley Gerthsen/Vogel, <i>Physik</i>, Springer Verlag Hering/Martin/Stohrer, <i>Physik für Ingenieure</i>, VDI-Verlag | |

| ourse L0368: Physics for Engineers (Problem Solving Course) | |
|---|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| CP | 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: Chem | ictry | | | | |
|-----------------------------|---|---------------------------------------|----------------------|----------------|----------------------|
| Module M0007: Chem | istry | | | | |
| Courses | | | | | |
| Гitle | | Тур | ŀ | lrs/wk | СР |
| Chemistry I (L0460) | | Lecture | 2 | 1 | 2 |
| Chemistry I (L0475) | | Recitation Section | on (large) 1 | | 1 |
| Chemistry II (L0465) | | Lecture | 2 | 1 | 2 |
| Chemistry II (L0476) | | Recitation Section | on (large) 1 | | 1 |
| Module Responsible | Dr. Dorothea Rechtenbach | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | none | | | | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students have | e reached the following learning resu | llts | | |
| Professional Competence | | | | | |
| Knowledge | The students are able to name and to descr | | - | | |
| | table, chemical bonds), physical chemist | ry (aggregate states, separating | processes, thermo | odynamics, | kinetics), inorgani |
| | chemistry (acid/base, pH-value, salts, solub | ility, redox, metals) and organic che | emistry (aliphatic h | ydrocarbon | s, functional groups |
| | carbonyl compounds, aromates, reaction n | nechanisms, natural products, synth | netic polymers). Fu | rthermore s | students are able t |
| | explain basic chemical terms. | | | | |
| | | | | | |
| | | | | | |
| Skills | After successful completion of this module s | tudents are able to describe substar | nce groups and che | mical comp | ounds. On this basis |
| | they are capable of explaining, choosing an | | | | |
| | | | | | |
| | | | | | |
| Personal Competence | | | | | |
| | Students are able to take part in discussion | s on chemical issues and problems a | is a member of an i | interdiscipli | nary team. They ca |
| Secial competence | contribute to those discussion by their own | | | incer diberphi | |
| | | | | | |
| | | | | | |
| Autonomy | After successful completion of this module | students are able to solve chemica | al problems indene | ndently by | defending propose |
| Autonomy | approaches with arguments. They can also | | | nachtry by | derending propose |
| | approaches war arguments. They can also | accument their approaches. | | | |
| | | | | | |
| Workload in Hours | Independent Study Time 96, Study Time in | ecture 84 | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| | Written exam | | | | |
| Examination duration and | 120 min | | | | |
| scale | | | | | |
| | General Engineering Science (German prog | am 7 semester): Core Qualification | Compulsony | | |
| Following Curricula | Civil- and Environmental Engineering: Core | | compuisory | | |
| ronowing curricula | | | | | |
| | Technomathematics: Specialisation III. Engin | ieering science: Elective Compulsor | ý | | |

| 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 | DE | |
| 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. | |

| ourse 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 L04 | Course L0465: Chemistry II | | |
|------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload | Independent Study Time 32, Study Time in Lecture 28 | | |
| in Hours | | | |
| 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: Chemistry II | urse L0476: Chemistry II | |
|----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | 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 | |

| Courses | | | | |
|--|---|--|------------------|----------------|
| | | | | |
| Title Programming in C (L0083) | | Typ Lecture | Hrs/wk | CP 1 |
| Programming in C (L1488) | | Practical Course | 1 | 1 |
| Module Responsible | Prof. Siegfried Rump | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Elementary PC handling skills | | | |
| Knowledge | | | | |
| | Elementary mathematical skills | | | |
| Educational Objectives | After taking part successfully, students h | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students know by heart the basic syr | ntax of C programming as well as its meaning, i | ntent and | |
| | purpose. | | | |
| | They know the fundamental common ante | and mindiales of elementary provided by | | |
| | based on C programming and can explain | and principles of elementary procedural progra | imming | |
| | based on e programming and can explain | r them. | | |
| | basic data types (integers, floating point | nt numbers, characters) | | |
| | | strings, composed data types, type conversion |) | |
| | operators (arithmetical operations, logi | | | |
| | control flow (choice, loops, jumps, cond | litional compilation) | | |
| | functions and macros important standard libraries and function | | | |
| | recursion | 5115 | | |
| | Inked lists | | | |
| | | programming lectures like object oriented prog | gramming in C++. | |
| | | | | |
| Skills | | ted development environment for C programm | ing on a PC | |
| | so that they can write, store, compile and | d execute C programs on it. | | |
| | Using their knowledge they are able to re | ad and understand given C Programs. | | |
| | They can solve simple algorithmic proble in C language. | ms on their own and can model and program th | eir solutions | |
| | The students are able to calve colorised a | versions from other eress of their study like me | themetice | |
| | | exercises from other areas of their study like ma sics with the aid of small C programs/-projects r | | |
| | meenames, electrical engineering of phys | sies with the did of small e programs/-projects r | lumencany. | |
| Personal Competence | | | | |
| Social Competence | | ams to solve given weekly tasks, to identify and | l analyze | |
| | programming errors and to present their | results. | | |
| | They are able to explain simple phenome | ena to each other directly at the PC. | | |
| Autonomy | The students prepare themselves using t | he given teaching material and solve the given | | |
| | programming exercises on their own. | ···· | | |
| | | | | |
| | | to understand and check addressed issues and | also to | |
| | gain a certain programming experience. | | | |
| | For details beyond the scope of the lecture | re the students inform themselves using the sta | ated | |
| | literature and / or by supplementary own | research. | | |
| | | | | |
| Workload in Hours | Independent Study Time 32, Study Time | in Lecture 28 | | |
| Credit points | | | | |
| Course achievement | | | | |
| | Written elaboration | | | |
| Examination duration and | 1-2 coding tasks weekly | | | |
| scale | Concern Engineering Spin (C | | | |
| Assignment for the | General Engineering Science (German pr | ogram, 7 semester): Core Qualification: Compu | isory | |

| Course L0083: Programming | in C |
|---------------------------|---|
| Тур | Lecture |
| Hrs/wk | 1 |
| CP | 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: |
| | 1. basic data types (integers, floating point numbers, characters, boolean values) |
| | advanced data types (meegers, nothing point numbers, end accers, boolean values) advanced data types (pointers, arrays, strings, composed data types, type conversion) |
| | 3. operators (arithmetical operations, logical operations, bit operations) |
| | |
| | 4. control flow (choice, loops, jumps, conditional compilation) |
| | 5. 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) |
| | 6. important standard libraries and functions (stdio.h, stdlib.h, math.h, string.h, ctype.h, time.h) |
| | 7. 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 |
| CP | 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: Elect | rical Engineering II: Alternating Curre | nt Networks and Basic De | vices | |
|---------------------------------------|--|---|--------------------|---------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| | g Current Networks and Basic Devices (L0178) | Lecture | 3 | 5 |
| Electrical Engineering II: Alternatin | g Current Networks and Basic Devices (L0179) | Recitation Section (small) | 2 | 1 |
| Module Responsible | Prof. Christian Becker | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Electrical Engineering I | | | |
| Knowledge | Mathematics I | | | |
| | | | | |
| | Direct current networks, complex numbers | | | |
| | | | | |
| Educational Objectives | | | | |
| | After taking part successfully, students have reached t | he following learning results | | |
| Professional Competence | Students are able to reproduce and explain fundame | ntal theories, principles, and methods | rolated to the | theory of alternati |
| Knowledge | currents. They can describe networks of linear elemen | | | - |
| | an overview of applications for the theory of alternat | | - | |
| | explaining the behavior of fundamental passive and ac | | | |
| | | | | |
| | | | | |
| Skills | Students are capable of calculating parameters within | n simple electrical networks at alterna | ting currents by | means of a compl |
| | notation for voltages and currents. They can apprai | se the fundamental effects that may | occur within el | lectrical networks |
| | alternating currents. Students are able to analyze s | simple circuits such as oscillating cir | cuits, filter, and | matching networ |
| | quantitatively and dimension elements by means of | a design. They can motivate and just | tify the fundame | ental elements of |
| | electrical power supply (transformer, transmission line | e, compensation of reactive power, mu | ultiphase system) | and are qualified |
| | dimension their main features. | | | |
| | | | | |
| Personal Competence | | | | |
| - | Students are able to work together on subject related t | asks in small groups. They are able to | present their res | ults effectively. |
| | | | | |
| | | | | |
| Autonomy | Students are capable to gather necessary information | from the references provided and relation | ate that informat | ion to the context |
| | the lecture. They are able to continually reflect their kn | | | |
| | tests and exercises that are related to the exam. Bas | | | |
| | learning process. They are able to draw connections | | this lecture and | the content of oth |
| | lectures (e.g. Electrical Engineering I, Linear Algebra, a | nd Analysis). | | |
| | | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 |) | | |
| Credit points | 6 | | | |
| Course achievement | Compulsory Bonus Form Des | cription | | |
| | No 10 % Midterm | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 - 150 minutes | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 sem | ester): Core Qualification: Compulsory | | |
| Following Curricula | Electrical Engineering: Core Qualification: Compulsory | | | |
| | Computational Science and Engineering: Core Qualifica | ition: Compulsory | | |
| | Mechatronics: Core Qualification: Compulsory | | | |
| | Orientierungsstudium: Core Qualification: Elective Com | ipulsory | | |

| Course L0178: Electrical Engineering II: Alternating Current Networks and Basic Devices | | |
|---|---|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| СР | 5 | |
| Workload in Hours | Independent Study Time 108, Study Time in Lecture 42 | |
| Lecturer | Prof. Christian Becker | |
| Language | DE | |
| Cycle | SoSe | |
| Content | - 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 | |
| | - 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 | |
| | | |
| Literature | - 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) | |
| | - 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: Electrical Engineering II: Alternating Current Networks and Basic Devices | | |
|---|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| CP | 1 | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | |
| Lecturer | Prof. Christian Becker | |
| Language | DE | |
| Cycle | SoSe | |
| Content | - 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 | |
| | - 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 | |
| | | |
| Literature | - 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) | |
| | - C. Kautz, "Tutorien zur Elektrotechnik", Pearson (2009) | |
| | - A. Hambley, "Electrical Engineering: Principles and Applications", Pearson (2013) | |
| | - R. Dorf, "The Electrical Engineering Handbook", CRC (2006) | |
| | | |

| Courses | | | | |
|-----------------------------------|--|---|-------------------|----------------------|
| Title | | Тур | Hrs/wk | СР |
| Fundamentals of Mechanical Engin | eering Design (L0258) | Lecture | 2 | 3 |
| Fundamentals of Mechanical Engin | eering Design (L0259) | Recitation Section (large) | 2 | 3 |
| Module Responsible | Prof. Dieter Krause | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Basic knowledge about mechanics an Internship (Stage I Practical) | d production engineering | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning results | | |
| Professional Competence | | | | |
| - | After passing the module, students are able | to: | | |
| | | | | |
| | explain basic working principles and f | | | |
| | | ia, application scenarios and practical exampl | es of basic machi | ne elements, indica |
| | the background of dimensioning calcu | llations. | | |
| Skills | After passing the module, students are able | to: | | |
| | accomplish dimensioning calculations of covered machine elements, | | | |
| | | of covered machine elements, dule to new requirements and tasks (problem s | | |
| | recognize the content of technical dra | | olving skins), | |
| | technically evaluate basic designs. | wings and schematic sketches, | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to discuss technical | information in the lecture supported by actival | ing methods. | |
| Autonomy | | | | |
| | | eepen their acquired knowledge in exercises. | | |
| | | al knowledge and to recapitulate poorly unde | rstood content e. | g. by using the vide |
| | recordings of the lectures. | | | |
| Workload in Hours | Independent Study Time 124, Study Time in | Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German progr | am, 7 semester): Core Qualification: Compulsor | У | |
| Following Curricula | Energy and Environmental Engineering: Core | | | |
| | Logistics and Mobility: Core Qualification: Co | | | |
| | Mechanical Engineering: Core Qualification: | | | |
| | Mechatronics: Core Qualification: Compulsor | • | | |
| | Orientierungsstudium: Core Qualification: Ele | | | |
| | Naval Architecture: Core Qualification: Comp | | | |
| | Technomathematics: Specialisation III. Engin | eering science: Elective Compulsory | | |

| _ | s of Mechanical Engineering Design | | |
|-------------------|---|--|--|
| | Lecture | | |
| Hrs/wk | 2 | | |
| CP | 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 | Lecture | | |
| | Introduction to design | | |
| | Introduction to the following machine elements | | |
| | Screws | | |
| | Shaft-hub joints | | |
| | Rolling contact bearings | | |
| | Welding / adhesive / solder joints | | |
| | • Springs | | |
| | • Axes & shafts | | |
| | | | |
| | Presentation of technical objects (technical drawing) | | |
| | Exercise | | |
| | Calculation methods for dimensioning the following machine elements: | | |
| | Screws | | |
| | Shaft-hub joints | | |
| | Rolling contact bearings | | |
| | Welding / adhesive / solder joints | | |
| | • Springs | | |
| | • Axis & shafts | | |
| Literature | | | |
| | Dubbel, Taschenbuch f ür 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. Sourie weitere Bücher zu gestiellen Themen | | |
| | 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 |

| 6 | | | | |
|--|---|--|--------|----|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Mechanics II (L0493) | | Lecture | 2 | 2 |
| Mechanics II (L0494) Mechanics II (L1691) | | Recitation Section (small) Recitation Section (large) | 2 | 2 |
| Module Responsible | Prof. Christian Cyron | | | |
| Admission Requirements | | | | |
| Recommended Previous | Mechanics I | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students h | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students name the fundamental concepts and laws of statics such as stresses, strains, Hooke's linear law. | | | |
| Skills | The students apply the mathematical/mechanical analysis and modeling. | | | |
| | The students apply the fundamental met | hods of elasto statics to simply engineering problem | c | |
| | | indus of elasto statics to simply engineering problem. | 5. | |
| | The students estimate the validity and li | mitations of the introduced methods. | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | - | | | |
| Autonomy | - | | | |
| Workload in Hours | Independent Study Time 96, Study Time | in Lecture 84 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German pr | rogram, 7 semester): Core Qualification: Compulsory | | |
| Following Curricula | Civil- and Environmental Engineering: Co | re Qualification: Compulsory | | |
| | Mechanical Engineering: Core Qualificati | on: Compulsory | | |
| | Mechatronics: Core Qualification: Compu | lsory | | |
| | Orientierungsstudium: Core Qualification | : Elective Compulsory | | |
| | Naval Architecture: Core Qualification: C | ompulsory | | |

| Course L0493: Mechanics II | |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 | ourse L0494: Mechanics II | |
|----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| CP | 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 | ourse L1691: Mechanics II | |
|----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Christian Cyron, Dr. Konrad Schneider | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Module M0671: Techr | ical Thermodynamics I | | | |
|----------------------------------|--|--|--------------------|---------------------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Technical Thermodynamics I (L043 | 7) | Lecture | 2 | 4 |
| Technical Thermodynamics I (L043 | | Recitation Section (large) | 1 | 1 |
| Technical Thermodynamics I (L044 | | Recitation Section (small) | 1 | 1 |
| Module Responsible | | | | |
| Admission Requirements | None | | | |
| | Elementary knowledge in Mathematics and Mech | anics | | |
| Knowledge | | | | |
| | After taking part successfully, students have read | ched the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are familiar with the laws of Thermod | ynamics. They know the relation of the kind | ds of energy acc | ording to 1 st law o |
| | Thermodynamics and are aware about the limits | of energy conversions according to $2^{\mbox{nd}}$ law | of Thermodynan | nics. They are able t |
| | distinguish between state variables and process | s variables and know the meaning of differ | ent state variab | les like temperature |
| | enthalpy, entropy and also the meaning of exe | ergy and anergy. They are able to draw the | e Carnot cycle ir | a Thermodynamic |
| | related diagram. They know the physical different | - | | |
| | state. They know the meaning of a fundamental | state of equation and know the basics of two | phase Thermody | ynamics. |
| | | | | |
| | | | | |
| Skills | Students are able to calculate the internal energ | | | |
| | simple change of states and to use this calculatio | | culate state varia | ables for an ideal an |
| | for a real gas from measured thermal state varia | bles. | | |
| | | | | |
| Demonstration of the second | | | | |
| Personal Competence | The students are able to discuss in small groups | and develop on ennroach | | |
| | Students are able to define independently tasks, | | dao as woll as to | find ways to use th |
| Autonomy | knowledge in practice. | to get new knowledge from existing knowle | uge as well as to | iniu ways to use th |
| | klowledge in proceee. | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lect | cure 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, | 7 semester): Core Qualification: Compulsory | | |
| Following Curricula | Bioprocess Engineering: Core Qualification: Comp | pulsory | | |
| | Energy and Environmental Engineering: Core Qua | | | |
| | General Engineering Science (English program, 7 | | | |
| | Computational Science and Engineering: Speciali | | Ilsory | |
| | Mechanical Engineering: Core Qualification: Com | pulsory | | |
| | Mechatronics: Core Qualification: Compulsory | - Commutation | | |
| | Orientierungsstudium: Core Qualification: Electiv | | | |
| | Naval Architecture: Core Qualification: Compulso | | | |
| | Technomathematics: Specialisation III. Engineerin | | | |
| | Process Engineering: Core Qualification: Compuls | богу | | |

| Course L0437: Technical The | rmodynamics I |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. Gerhard Schmitz |
| Language | DE |
| Cycle | SoSe |
| Content | 1. Introduction |
| | 2. Fundamental terms |
| | 3. Thermal Equilibrium and temperature |
| | 3.1 Thermal equation of state |
| | 4. First law |
| | 4.1 Heat and work |
| | 4.2 First law for closed systems |
| | 4.3 First law for open systems |
| | 4.4 Examples |
| | 5. Equations of state and changes of state |
| | 5.1 Changes of state |
| | 5.2 Cycle processes |
| | 6. Second law |
| | 6.1 Carnot process |
| | 6.2 Entropy |
| | 6.3 Examples |
| | 6.4 Exergy |
| | 7. Thermodynamic properties of pure fluids |
| | 7.1 Fundamental equations of Thermodynamics |
| | 7.2 Thermodynamic potentials |
| | 7.3 Calorific state variables for arbritary fluids |
| | 7.4 state equations (van der Waals u.a.) |
| | |
| 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 The | ourse L0439: Technical Thermodynamics I | |
|-----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | 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 The | ourse L0441: Technical Thermodynamics I | |
|-----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| CP | 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 | |

| Module M0851: Math | ematics II | | | |
|--|--|--|--------------------|-----------------------|
| Courses | | | | |
| Title | | Typ | Hrs/wk | СР |
| Analysis II (L1025) | | Typ Lecture | 2 | 2 |
| Analysis II (L1026) | | | 2 | 1 |
| Analysis II (L1020) | | Recitation Section (large) Recitation Section (small) | 1 | 1 |
| Linear Algebra II (L0915) | | Lecture | 2 | 2 |
| Linear Algebra II (L0915) | | Recitation Section (small) | 1 | 1 |
| | | | 1 | 1 |
| Linear Algebra II (L0917) | | Recitation Section (large) | T | T |
| Module Responsible Admission Requirements | Prof. Anusch Taraz None | | | |
| Recommended Previous | Mathematics I | | | |
| Keconmended Previous Knowledge | Mathematics I | | | |
| Educational Objectives | After taking part successfully, students have reached th | e following learning results | | |
| Professional Competence | ······································ | | | |
| - | | | | |
| Knowledge | Students can name further concepts in analys | is and linear algebra. They are able | to explain the | m using appropriat |
| | examples. | <u> </u> | | 5 11 1 |
| | Students can discuss logical connections between | n these concents They are canable | of illustrating th | asa connections wit |
| | the help of examples. | in these concepts. They are capable | or muscialing th | ese connections wit |
| | | | | |
| | They know proof strategies and can reproduce the | em. | | |
| | | | | |
| | | | | |
| Skills | | | | |
| | Students can model problems in analysis and lin | ear algebra with the help of the conce | pts studied in th | is course. Moreover |
| | they are capable of solving them by applying est | ablished methods. | | |
| | Students are able to discover and verify further least | gical connections between the conce | ots studied in the | course. |
| | For a given problem, the students can develop | and execute a suitable approach, and | nd are able to ci | ritically evaluate th |
| | results. | | | |
| | | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| | Students are able to work together in teams. The | | | |
| | In doing so, they can communicate new concept | s according to the needs of their coop | erating partners | . Moreover, they ca |
| | design examples to check and deepen the under | standing of their peers. | | |
| | | | | |
| | | | | |
| Autonomy | | | | |
| Autonomy | Students are capable of checking their understa | nding of complex concepts on their o | wn. They can sp | ecify open question |
| | precisely and know where to get help in solving t | hem. | | |
| | Students have developed sufficient persistence | | s in a goal-orien | ted manner on har |
| | problems. | | | |
| | problems. | | | |
| | | | | |
| Workload in Hours | Independent Study Time 128, Study Time in Lecture 11 | 2 | | |
| Credit points | 8 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 60 min (Analysis II) + 60 min (Linear Algebra II) | | | |
| scale | - | | | |
| Assignment for the | General Engineering Science (German program, 7 seme | ster): Core Qualification: Compulsory | | |
| Following Curricula | Civil- and Environmental Engineering: Core Qualification | | | |
| i onowing curricula | | | | |
| | Bioprocess Engineering: Core Qualification: Compulsory | | | |
| | Electrical Engineering: Core Qualification: Compulsory | | | |
| | Energy and Environmental Engineering: Core Qualification | on: Compulsory | | |
| | Computational Science and Engineering: Core Qualificat | ion: Compulsory | | |
| | Logistics and Mobility: Core Qualification: Compulsory | | | |
| | Mechanical Engineering: Core Qualification: Compulsory | | | |
| | Mechatronics: Core Qualification: Compulsory | | | |
| | | aulson/ | | |
| | Orientierungsstudium: Core Qualification: Elective Comp | Juisol y | | |
| | Naval Architecture: Core Qualification: Compulsory | | | |
| | Process Engineering: Core Qualification: Compulsory | | | |

| Course L1025: Analysis II | |
|---------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 | urse L1026: Analysis II | |
|---------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | 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 | ourse L1027: Analysis II | |
|---------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| CP | 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 | |

| urse L0915: Linear Algebra | a II |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 Algebra | a II |
|------------------------------|--|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| CP | 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 | urse L0917: Linear Algebra II | | |
|------------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| CP | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Anusch Taraz, Prof. Marko Lindner, Dr. Christian Seifert, Dr. Julian Großmann | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| C | | | | |
|--|---|---|--|--|
| Courses | | | | |
| Fitle | | Тур | Hrs/wk | СР |
| Technical Thermodynamics II (L044 Technical Thermodynamics II (L045 | | Lecture Recitation Section (large) | 2 1 | 4 1 |
| Technical Thermodynamics II (L045 | | Recitation Section (angle) | 1 | 1 |
| Module Responsible | | | | |
| Admission Requirements | None | | | |
| • | Elementary knowledge in Mathematics, Mech | vanice and Technical Thormodynamice I | | |
| Recommended Previous Knowledge | Elementary knowledge in Mathematics, Mech | lanics and recinical mermodynamics i | | |
| | After taking part successfully, students have | reached the following learning results | | |
| Professional Competence | After taking part successfully, students have | reached the following learning results | | |
| Skills | derive energetic and exergetic efficiencies clockwise and clockwise cycles (heat-power draw the different cycles in Thermodynam processes and are able to perform simple co know the definition of the speed of sound an Students are able to use thermodynamic law exergy- and entropy balances and by this to | cesses like Joule, Otto, Diesel, Stirling, Seiliger and know the influence different factors. Th cycle, cooling cycle). They have increased kno ics related diagrams. They know the laws of mbustion calculations. They are provided with d know about a Laval nozzle. ws for the design of technical processes. Especie optimise technical processes. They are able to They are able to transform a verbal formula | ey know the diffe wledge of steam c gas mixtures, esp basic knowledge ally they are able o perform simple s | erence between a ycles and are able becially of humid in gas dynamics a to formulate energy safety calculations |
| Personal Competence | | | | |
| Social Competence | The students are able to discuss in small gro | ups and develop an approach. | | |
| Autonomy | Students are able to define independently ta knowledge in practice. | sks, to get new knowledge from existing knowl | edge as well as to | find ways to use t |
| Workload in Hours | Independent Study Time 124, Study Time in | Lecture 56 | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | | | | |
| Examination duration and | | | | |
| scale | | | | |
| | General Engineering Science (German progra | am, 7 semester): Core Qualification: Compulson | / | |
| - | Bioprocess Engineering: Core Qualification: C | | , | |
| rollowing Curricula | Energy and Environmental Engineering: Core | | | |
| | Energy Systems: Technical Complementary (| | | |
| | Engineering Science: Core Qualification: Com | | | |
| | Engineering Science: Specialisation Mechanic | | | |
| | 5 5 | m, 7 semester): Core Qualification: Compulsory | | |
| | | m, 7 semester): Specialisation Mechanical Engi | | ompulsory |
| | | cialisation Engineering Sciences: Elective Comp | | |
| | Mechanical Engineering: Core Qualification: (| | | |
| | | | | |
| | Mechatronics: Core Qualification: Compulsor | / | | |
| | Mechatronics: Core Qualification: Compulsor Technomathematics: Specialisation III. Engin | | | |

| Course L0449: Technical 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 The | ourse L0450: Technical Thermodynamics II | |
|-----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | 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 The | Course L0451: Technical Thermodynamics II | |
|-----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| CP | 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: Mech | anics III (Dynamics) | | | |
|--|---|--|----------------------|----------------------|
| Courses | | | | |
| | | T | Have to also | <u></u> |
| Title | | Typ Lecture | Hrs/wk 3 | СР 3 |
| Mechanics III (Dynamics) (L1134) Mechanics III (Dynamics) (L1135) | | Recitation Section (small) | 2 | 2 |
| Mechanics III (Dynamics) (L1136) | | Recitation Section (Iarge) | 1 | 1 |
| | Prof. Robert Seifried | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mathematics I, II, Mechanics I (Statics) | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students h | ave reached the following learning results | | |
| Professional Competence | | · · · | | |
| Knowledge | The students can | | | |
| | | | | |
| | describe the axiomatic procedure | | | |
| | explain important steps in model of | - | | |
| | present technical knowledge in stereostatics. | | | |
| Skills | The students can | | | |
| | | | formation and an | |
| | | f mathematical / mechanical analysis and model | formation, and appl | ly it to the context |
| | their own problems; | ic and kinetic methods to engineering problems; | | |
| | | | icable to wider prob | lom coto |
| | estimate the reach and boundaries | s of statical methods and extend them to be appl | | iem sets. |
| Personal Competence | | | | |
| Social Competence | The students can work in groups and sup | port each other to overcome difficulties. | | |
| Autonomy | Students are capable of determining thei | r own strengths and weaknesses and to organize | their time and learr | ning based on thos |
| Workload in Hours | Independent Study Time 96, Study Time | in Lecture 84 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German pr | ogram, 7 semester): Core Qualification: Compuls | ory | |
| Following Curricula | Data Science: Core Qualification: Elective | Compulsory | | |
| | Digital Mechanical Engineering: Core Qua | alification: Compulsory | | |
| | Mechanical Engineering: Core Qualification | on: Compulsory | | |
| | Mechatronics: Core Qualification: Compu | lsory | | |
| | Naval Architecture: Core Qualification: Co | ompulsory | | |
| | Technomathematics: Specialisation III. Er | aning aning Calendary Flacting Computers | | |

| urse L1134: Mechanics III | (Dynamics) |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Prof. Robert Seifried |
| Language | DE |
| Cycle | WiSe |
| Content | 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). |

| Typ Recitation Section (small) Hrs/wk 2 CP 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 | |
|--|--|
| CP 2 Workload in Hours Independent Study Time 32, Study Time in Lecture 28 Lecturer Prof. Robert Seifried Language DE Cycle WiSe | |
| Workload in Hours Independent Study Time 32, Study Time in Lecture 28 Lecturer Prof. Robert Seifried Language DE Cycle WiSe | |
| Lecturer Prof. Robert Seifried Language DE Cycle WiSe | |
| Language DE Cycle WiSe | |
| Cycle WiSe | |
| | |
| Content Con interleating course | |
| Content See Interlocking course | |
| Literature See interlocking course | |
| | |

| Yeitation Section (large) Restation Section (large) Instruction I Yeitation Section (large) Instruction I Yeitation Section (large) Instruction Instrest Instruction | Course L1136: Mechanics III | (Dynamics) |
|--|-----------------------------|---|
| CP 1 Workload in Hours Independent Study Time 16, Study Time in Lecture 14 Lecture Prof. Robert Seifried DE Vise Content See interlocking course | Тур | Recitation Section (large) |
| Workload in Hours Independent Study Time 16, Study Time in Lecture 14 Lecture Prof. Robert Seifried Language DE Cycle Wise Content See interlocking course | Hrs/wk | 1 |
| Lecturer Prof. Robert Seifried Language DE Cycle WiSe Content See interlocking course | СР | 1 |
| Language DE Cycle WiSe Content See interlocking course | Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Cycle WiSe Content See interlocking course | Lecturer | Prof. Robert Seifried |
| Content See interlocking course | Language | DE |
| 5 | Cycle | WiSe |
| Literature See interlocking course | Content | See interlocking course |
| | Literature | See interlocking course |

| Module M0853: Mathe | ematics III | | | |
|--------------------------------------|--|---|--------------------|----------------------|
| Courses | | | | |
| Title | | True | | CD. |
| Analysis III (L1028) | | Typ Lecture | Hrs/wk 2 | CP 2 |
| Analysis III (L1029) | | Recitation Section (small) | 1 | 1 |
| Analysis III (L1030) | | Recitation Section (large) | 1 | 1 |
| Differential Equations 1 (Ordinary E | ifferential Equations) (L1031) | Lecture | 2 | 2 |
| Differential Equations 1 (Ordinary E | Differential Equations) (L1032) | Recitation Section (small) | 1 | 1 |
| Differential Equations 1 (Ordinary E | Differential Equations) (L1033) | Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof. Anusch Taraz | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mathematics I + II | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached | d the following learning results | | |
| Professional Competence | | | | |
| Knowledge | | | | |
| nite medge | Students can name the basic concepts in the a | area of analysis and differential equations | s. They are able | to explain them usi |
| | appropriate examples. | | | |
| | Students can discuss logical connections betw | ween these concepts. They are capable | of illustrating th | ese connections w |
| | the help of examples. | | | |
| | They know proof strategies and can reproduce | e them. | | |
| | | | | |
| Skills | | | | |
| Skiis | Students can model problems in the area of a | nalysis and differential equations with th | e help of the co | ncepts studied in t |
| | course. Moreover, they are capable of solving | them by applying established methods. | | |
| | Students are able to discover and verify further | er logical connections between the conce | pts studied in the | e course. |
| | For a given problem, the students can deve | lop and execute a suitable approach, a | nd are able to c | ritically evaluate t |
| | results. | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| | Students are able to work together in teams. | | | |
| | In doing so, they can communicate new concerning | | erating partners | . Moreover, they c |
| | design examples to check and deepen the uno | derstanding of their peers. | | |
| | | | | |
| | | | | |
| Autonomy | Students are capable of checking their under | standing of complex concepts on their o | wn They can sr | ecify open questio |
| | precisely and know where to get help in solvir | | with they can sp | centy open questio |
| | Students have developed sufficient persisten | | s in a goal-orier | ted manner on ha |
| | problems. | ice to be able to work for longer period | s in a goal-onei | |
| | problems. | | | |
| | | | | |
| Workload in Hours | Independent Study Time 128, Study Time in Lecture | 112 | | |
| Credit points | | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 60 min (Analysis III) + 60 min (Differential Equations | 1) | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 se | mester): Core Qualification: Compulsory | | |
| Following Curricula | Civil- and Environmental Engineering: Core Qualificat | tion: Compulsory | | |
| | Bioprocess Engineering: Core Qualification: Compuls | ory | | |
| | Computer Science: Core Qualification: Compulsory | | | |
| | Data Science: Core Qualification: Compulsory | | | |
| | Digital Mechanical Engineering: Core Qualification: C | compulsory | | |
| | Electrical Engineering: Core Qualification: Compulsor | ТУ Т | | |
| | Energy and Environmental Engineering: Core Qualific | cation: Compulsory | | |
| | Engineering Science: Core Qualification: Compulsory | | | |
| | General Engineering Science (English program, 7 ser | | | |
| | Computational Science and Engineering: Core Qualifi | | | |
| | Mechanical Engineering: Core Qualification: Computs | | | |
| | Mechatronics: Core Qualification: Compulsory | | | |
| | Naval Architecture: Core Qualification: Compulsory | | | |
| | Process Engineering: Core Qualification: Compulsory | | | |
| | riocess Engineering. Core Quanneacion. Compuisory | | | |

| 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: Differential Equations 1 (Ordinary Differential Equations) | |
|--|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 |
| Literature | 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 |

| ourse L1032: Differential Equations 1 (Ordinary Differential Equations) | |
|---|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| CP | 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 |
| | |
| ourse L1033: Differential E | quations 1 (Ordinary Differential Equations) |
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| CP | 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

Literature

See interlocking course

See interlocking course

| Courses | | | | |
|-----------------------------|--|--|--------------------------------------|---------------------------------------|
| Title | | Turn | Hre /urk | СР |
| Signals and Systems (L0432) | | Typ Lecture | Hrs/wk 3 | 4 |
| Signals and Systems (L0433) | | Recitation Section (small) | 2 | 2 |
| Module Responsible | Prof. Gerhard Bauch | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | | | | |
| - | The modul is an introduction to the theory of signals and 1-3 is expected. Further experience with spectral transf but not required. | | - | |
| Educational Objectives | After taking part successfully, students have reached the | e following learning results | | |
| Professional Competence | ······ | · · · · · · · · · · · · · · · · · · · | | |
| Knowledge | The students are able to classify and describe signals at theory. They are able to apply the fundamental transfor can describe and analyse deterministic signals and sys understand the effects in time domain and image dom discrete-time signal. | rmations of continuous-time and disc tems mathematically in both time a | rete-time signals nd image domair | and systems. T n. In particular, 1 |
| Skills | The students are able to describe and analyse determin system theory. They can analyse and design basic s response, stability, linearity etc They can assess the im | systems regarding important proper | ties such as ma | gnitude and ph |
| Personal Competence | | | | |
| Social Competence | The students can jointly solve specific problems. | | | |
| Autonomy | The students are able to acquire relevant information knowledge during the lecture period by solving tutorial p | | - | ontrol their leve |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 semes | ster): Core Qualification: Compulsory | | |
| Following Curricula | Computer Science: Core Qualification: Compulsory | | | |
| | Data Science: Core Qualification: Compulsory | | | |
| | Electrical Engineering: Core Qualification: Compulsory | | | |
| | General Engineering Science (English program, 7 semest | | | |
| | General Engineering Science (English program, 7 semest | | | У |
| | General Engineering Science (English program, 7 semest General Engineering Science (English program, 7 se Compulsory | emester): Specialisation Mechanica | Engineering, F | |
| | General Engineering Science (English program, 7 ser Compulsory General Engineering Science (English program, 7 ser | · | | |
| | Engineering: Compulsory General Engineering Science (English program, 7 senes) | | 5 5. | 5 |
| | Sciences: Compulsory General Engineering Science (English program, 7 s | | 5. | 5 |
| | Compulsory General Engineering Science (English program, 7 semes | · | | |
| | Engineering: Compulsory General Engineering Science (English program, 7 semest | ter): Specialisation Process Engineeri | ng: Compulsory | |
| | General Engineering Science (English program, 7 semest Computational Science and Engineering: Core Qualificati | | ering: Compulsor | У |
| | Mechatronics: Core Qualification: Compulsory | | | |

| Course L0432: Signals and S | ystems |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Gerhard Bauch |
| Language | DE/EN |
| Cycle | SoSe |
| Content | Introduction to signal and system theory |
| | • Signals |
| | Classification of signals |
| | Continuous-time and discrete-time signals |
| | Analog and digital signals |

- Deterministic and random signals
- Description of LTI systems by differential equations or difference equations, respectively
- Basic properties of signals and operations on signals
- Elementary signals
- Distributions (Generalized Functions)
- Power and energy of signals
- Correlation functions of deterministic signals
 - Autocorrelation functionCrosscorrelation function

 - Orthogonal signals
 - Applications of correlation
- Linear time-invariant (LTI) systems
 - LinearityTime-invariance
 - Description of LTI systems by impulse response and frequency response
 - Convolution
 - Convolution and correlation
 - Properties of LTI-systems
 - Causal systems
 - Stable systems
 - Memoryless systems
- Fourier Series and Fourier Transform
 - Fourier transform of continuous-time signals, discrete-time signals, periodic signals, non-periodic signals
 - Properties of the Fourier transform
 - Fourier transform of some basic signals
 - Parseval's theorem
- Analysis of LTI-systems and signals in the frequency domain
 - Frequency response, magnitude response and phase response
 - Transmission factor, attenuation, gain
 - Frequency-flat and frequency-selective LTI-systems
 - Bandwidth definitions
 - · Basic types of systems (filters), lowpass, highpass, bandpass, bandstop systems
 - Phase delay and group delay
 - Linear-phase systems
 - Distortion-free systems
 - Spectrum analysis with limited observation window: Leakage effect
- Laplace Transform
 - Relation of Fourier transform and Laplace transform
 - Properties of the Laplace transform
 - Laplace transform of some basic signals
- Analysis of LTI-systems in the s-domain
 - Transfer function of LTI-systems
 - Relation of Laplace transform, magnitude response and phase response
 - Analysis of LTI-systems using pole-zero plots
 - Allpass filters
 - Minimum-phase, maximum-phase and mixed phase filters
 - Stable systems
- Sampling
 - Sampling theorem
 - Reconstruction of continuous-time signals in frequency domain and time domain
 - Oversampling
 - Aliasing
 - Sampling with pulses of finite duration, sample and hold
- Decimation and interpolation
- Discrete-Time Fourier Transform (DTFT)
 - Relation of Fourier transform and DTFT
 - Properties of the DTFT
- Discrete Fourier Transform (DFT)
 - Relation of DTFT and DFT
 - Cyclic properties of the DFT
 - DFT matrix
 - Zero padding
 - Cyclic convolution
 - Fast Fourier Transform (FFT)
 - Application of the DFT: Orthogonal Frequency Division Multiplex (OFDM)
- Z-Transform
 - Relation of Laplace transform, DTFT, and z-transform
 - Properties of the z-transform
 - Z-transform of some basic discrete-time signals
- Discrete-time systems, digital filters
 - FIR and IIR filters
 - Z-transform of digital filters
 - Analysis of discrete-time systems using pole-zero plots in the z-domain
 - Stability
 - Allpass filters

| | Minimum-phase, maximum-phase and mixed-phase filters Linear phase 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 | | | | | | | |
|---|--|--|--|--|--|--|--|
| litle | | Typ | Hrs/wk | СР | | | |
| ntroduction to Control Systems (L | 0654) | Typ Lecture | нгs/wк 2 | 4 | | | |
| ntroduction to Control Systems (L | | Recitation Section (small) | 2 | 2 | | | |
| Module Responsible | Prof. Herbert Werner | | | | | | |
| Admission Requirements | None | | | | | | |
| Recommended Previous | Representation of signals and systems in time an | nd frequency domain, Laplace transform | | | | | |
| Knowledge | | | | | | | |
| | | | | | | | |
| | After taking part successfully, students have rea | ched the following learning results | | | | | |
| Professional Competence | | | | | | | |
| Knowledge | Students can represent dynamic system b | behavior in time and frequency domain, and | can in particular | explain properties | | | |
| | first and second order systems | | | | | | |
| | They can explain the dynamics of simple | control loops and interpret dynamic propertie | es in terms of free | quency response ar | | | |
| | root locus | wice and the stability proving deviced from i | | | | | |
| | They can explain the Nyquist stability crite They can explain the role of the phase ma | | | | | | |
| | They can explain the role of the phase may They can explain the way a PID controller | | | | | | |
| | They can explain issues arising when cont | | | digitally | | | |
| CI-III- | | | | | | | |
| Skills | • Students can transform models of linear d | ynamic systems from time to frequency dom | nain and vice vers | a | | | |
| | They can simulate and assess the behavior | or of systems and control loops | | | | | |
| | They can design PID controllers with the h | | | | | | |
| | They can analyze and synthesize simple c | | | | | | |
| | They can calculate discrete-time appro implementation | oximations of controllers designed in cor | itinuous-time an | d use it for digi | | | |
| | They can use standard software tools (Ma | tlab Control Toolbox, Simulink) for carrying o | ut these tasks | | | | |
| | | ···· · · · · · · · · · · · · · · · · · | | | | | |
| Personal Competence | | | | | | | |
| | Students can work in small groups to jointly solve | | | | | | |
| Autonomy | Students can obtain information from provided | sources (lecture notes, software document | Autonomy Students can obtain information from provided sources (lecture notes, software documentation, experiment gui | | | | |
| | when colving given problems | | | | | | |
| | when solving given problems. | | | | | | |
| | when solving given problems. They can assess their knowledge in weekly on-lir | ne tests and thereby control their learning pr | ogress. | | | | |
| | | ne tests and thereby control their learning pr | ogress. | | | | |
| | | ne tests and thereby control their learning pr | ogress. | | | | |
| | | ne tests and thereby control their learning pr | ogress. | | | | |
| Workload in Hours | | | ogress. | | | | |
| Workload in Hours Credit points | They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect | | ogress. | | | | |
| | They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 | | ogress. | | | | |
| Credit points Course achievement | They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 | | ogress. | | | | |
| Credit points Course achievement | They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam | | ogress. | | | | |
| Credit points Course achievement Examination | They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam | | ogress. | | | | |
| Credit points Course achievement Examination Examination duration and scale | They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam | ture 56 | | | | | |
| Credit points Course achievement Examination Examination duration and scale | They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, | ture 56 7 semester): Core Qualification: Compulsory | | | | | |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, | 7 semester): Core Qualification: Compulsory | | | | | |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Com Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu | 7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory Jlsory | | | | | |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Electrice Compu Electrical Engineering: Core Qualification: Compu | 7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory Jlsory | | | | | |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Compu Energy and Environmental Engineering: Core Qu | 7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory Jlsory Jlsory alification: Compulsory | | | | | |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Compu Energy and Environmental Engineering: Core Qu General Engineering Science (English program, 7 | 7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory Jlsory Jlsory alification: Compulsory ' semester): Specialisation Electrical Enginee | ring: Compulsory | | | | |
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| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Compu Energy and Environmental Engineering: Core Qua General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, 7 | 7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory Jlsory Jlsory alification: Compulsory ' semester): Specialisation Electrical Engineer ' semester): Specialisation Civil Engineering: ' semester): Specialisation Bioprocess Engine | ring: Compulsory Compulsory eering: Compulsor | ry | | | |
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| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-lir Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Compu Energy and Environmental Engineering: Core Qu General Engineering Science (English program, 7 General Engineering Science (English program, 7 | 7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory Jlsory alification: Compulsory ' semester): Specialisation Electrical Engineer ' semester): Specialisation Civil Engineering: ' semester): Specialisation Bioprocess Engine ' semester): Specialisation Energy and Enviro ' semester): Specialisation Energy and Enviro ' semester): Specialisation Computer Science | ring: Compulsory Compulsory eering: Compulsor omental Engineer e: Compulsory | ry ing: Compulsory | | | |
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| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-lin Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Comp Energy and Environmental Engineering: Core Qu General Engineering Science (English program, 7 General Engineering Science (English program, 7 Gener | 7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory Jlsory alification: Compulsory ' semester): Specialisation Electrical Engineer ' semester): Specialisation Electrical Engineer ' semester): Specialisation Bioprocess Engine ' semester): Specialisation Energy and Enviro ' semester): Specialisation Computer Science m, 7 semester): Specialisation Mechanical | ering: Compulsory Compulsory eering: Compulsor omental Engineer e: Compulsory al Engineering, Foc | ry ing: Compulsory Focus Biomechanic us Energy System | | | |
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| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-line Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Comput Electrical Engineering: Core Qualification: Comp Energy and Environmental Engineering: Core Qu General Engineering Science (English program, 7 General Engineering Science (English program Compulsory General Engineering Science (English program Compulsory | ture 56 7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory ulsory alification: Compulsory 2 semester): Specialisation Electrical Engineer 3 semester): Specialisation Electrical Engineer 3 semester): Specialisation Electrical Engineer 4 semester): Specialisation Electrical Engineer 5 semester): Specialisation Electrical Engineer 7 semester): Specialisation Energy and Enviror 7 semester): Specialisation Computer Science m, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical | ering: Compulsory Compulsory eering: Compulsor pomental Engineer e: Compulsory Il Engineering, Foc Engineering, Foc Engineering, Foc | ry ing: Compulsory Focus Biomechanic us Energy System rus Aircraft System | | | |
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| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-lin Independent Study Time 124, Study Time in Lect 6 None Written exam 120 min General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Computer Science: Specialisation Computational Data Science: Core Qualification: Elective Compu Electrical Engineering: Core Qualification: Comp Energy and Environmental Engineering: Core Qu General Engineering Science (English program, General Engineering Science (English program, Sciences: Compulsory General Engineering Science (English program, And Production: Compulsory | ture 56 7 semester): Core Qualification: Compulsory pulsory Mathematics: Elective Compulsory ilsory alification: Compulsory ' semester): Specialisation Electrical Engineer ' semester): Specialisation Electrical Engineer ' semester): Specialisation Bioprocess Engine ' semester): Specialisation Bioprocess Engine ' semester): Specialisation Energy and Envird ' semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanical r semester): Specialisation Mechanical m, 7 semester): Specialisation Mechanical Engin m, 7 semester): Specialisation Mechanical Engin m, 7 semester): Specialisation Mechanical Engin | ering: Compulsory Compulsory eering: Compulsor omental Engineer e: Compulsory al Engineering, Foc Engineering, Foc eering, Focus Mal al Engineering, I ineering, Focus P | ry ing: Compulsory Focus Biomechanic us Energy System tus Aircraft Syster terials in Engineerii Focus Mechatronic Product Developme | | | |
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| General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory |
|--|
| Green Technologies: Energy, Water, Climate: Core Qualification: Compulsory |
| Computational Science and Engineering: Core Qualification: Compulsory |
| Logistics and Mobility: Specialisation Engineering Science: Elective Compulsory |
| Logistics and Mobility: Specialisation Information Technology: Elective Compulsory |
| Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory |
| Logistics and Mobility: Specialisation Production Management and Processes: 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 |
| Engineering and Management - Major in Logistics and Mobility: Specialisation Information Technology: Elective Compulsory |
| Engineering and Management - Major in Logistics and Mobility: Specialisation Traffic Planning and Systems: Elective Compulsory |
| Engineering and Management - Major in Logistics and Mobility: Specialisation Production Management and Processes: Elective |
| Compulsory |

| Course L0654: Introduction t | o Control Systems |
|------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 plotsRoot 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 systemsSmith 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 t | ourse L0655: Introduction to Control Systems | | |
|------------------------------|---|--|--|
| Тур | citation Section (small) | | |
| Hrs/wk | 2 | | |
| CP | 2 | | |
| Workload in Hours | pendent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | f. Herbert Werner | | |
| Language | | | |
| Cycle | Se | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | |
|-----------------------------------|--|--|--|---|
| Title | | Тур | Hrs/wk | СР |
| Management Tutorial (L0882) | | Recitation Section (small) | 2 | 3 |
| Introduction to Management (L088) | 0) | Lecture | 3 | 3 |
| Module Responsible | Prof. Christoph Ihl | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic Knowledge of Mathematics and Business | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached | d the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After taking this module, students know the importa and Organisation to Marketing and Innovation, and a | | | |
| | explain the differences between Economics important definitions from the field of Manage explain the most important aspects of and g projects describe and explain basic business function organization and human ressource managem explain the relevance of planning and dec uncertainty, and explain some basic methods | ement goals in Management and name the most ons as production, procurement and so ent, information management, innovation ision making in Business, esp. in situa from mathematical Finance | : important aspe ourcing, supply management ar | cts of entreprneu chain manageme id marketing |
| Skills | state basics from accounting and costing and Students are able to analyse business units with res | spect to different criteria (organization, ob | jectives, strateg | ies etc.) and to ca |
| | out an Entrepreneurship project in a team. In particu | liar, they are able to | | |
| | analyse Management goals and structure the | m appropriately | | |
| | analyse organisational and staff structures of | | | |
| | apply methods for decision making under mul | | ıder risk | |
| | analyse production and procurement systems | | | |
| | analyse and apply basic methods of marketing | | | |
| | select and apply basic methods from mathem apply basic methods from accounting, costing | | | |
| | • apply basic methods norm accounting, costing | g 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 a | an entrepreneurship project and write a co | herent report on | the project |
| | to communicate appropriately and | | | |
| | to cooperate respectfully with their fellow stud | dents. | | |
| | | | | |
| Autonomy | Students are able to | | | |
| | work in a team and to organize the team then | nselves | | |
| | to write a report on their project. | | | |
| | | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture | 70 | | |
| Credit points | | | | |
| Course achievement | | | | |
| | Subject theoretical and practical work | | | |
| | several written exams during the semester | | | |
| scale | set and matter example and gring the settlester | | | |
| | General Engineering Science (German program, 7 se | emester): Core Qualification: Compulsory | | |
| Following Curricula | | | | |
| Ū. | Civil- and Environmental Engineering: Specialisation | | sory | |
| | Civil- and Environmental Engineering: Specialisation | | 5 | |
| | Bioprocess Engineering: Core Qualification: Compuls | sory | | |
| | Computer Science: Core Qualification: Compulsory | | | |
| | Data Science: Core Qualification: Compulsory | | | |
| | Electrical Engineering: Core Qualification: Compulsor | ry | | |
| | Energy and Environmental Engineering: Core Qualifi | | | |
| | General Engineering Science (English program, 7 sei | | | |
| | General Engineering Science (English program, 7 ser | | | |
| | General Engineering Science (English program, 7 ser | | | - |
| | General Engineering Science (English program, 7 ser | | | ng: Compulsory |
| | General Engineering Science (English program, 7 sei | mester): Specialisation Computer Science | compulsory | |
| | | 7 comoctor), Enocialization Marthan | Engineerin | OCULC Diama |
| | General Engineering Science (English program, | 7 semester): Specialisation Mechanical | Engineering, F | ocus Biomechan |
| | General Engineering Science (English program, Compulsory | | | |
| | General Engineering Science (English program, Compulsory General Engineering Science (English program, 7 | | | |
| | General Engineering Science (English program, Compulsory | semester): Specialisation Mechanical E | ngineering, Foc | us Energy Syster |

| 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 Naval Architecture: Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory |
| Green Technologies: Energy, Water, Climate: 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 |
| Orientation Studies: Core Qualification: Elective Compulsory |
| Orientation Studies: Core Qualification: Elective Compulsory |
| Naval Architecture: Core Qualification: Compulsory |
| Technomathematics: Core Qualification: Compulsory |
| Process Engineering: Core Qualification: Compulsory |
| Engineering and Management - Major in Logistics and Mobility: Core Qualification: Compulsory |
| |

| Course L08 | 82: Management Tutorial |
|------------|--|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 3 |
| Workload | Independent Study Time 62, Study Time in Lecture 28 |
| in Hours | |
| Lecturer | Prof. Christoph Ihl, Katharina Roedelius |
| 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 se |
| | 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 busin- 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 t | o Management |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 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. Corneliu |
| | 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, Innovatio Management, Marketing and Sales Cross-sectional Functions, e.g. Organisation, Human Ressource Management, Supply Chain Management, Informatio 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. Au Stuttgart 2005. Weber, J., Schäffer, U. : Einführung in das Controlling, 12. Auflage, Stuttgart 2008. |

| Courses | | | | |
|-----------------------------------|--|--|---------------------------|---------------------|
| Title | | Тур | Hrs/wk | СР |
| Advanced Intenship AIW/ ES: Inter | nship-accompanying Seminar (L2687) | Seminar | 1 | 0 |
| Advanced Internship AIW/ ES: Prep | aration (L2682) | Seminar | 1 | 0 |
| Module Responsible | Prof. Robert Seifried | | | |
| Admission Requirements | None | | | |
| Recommended Previous | 150 Creditpoints in General Engineering Scien | ce | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have r | eached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students of the different specialisations get ex | operiences in typical scope of duties of | engineers, who are worki | ing in a developme |
| | division, planning division or in the manage | ement of a company. In the framewo | ork of this environment | the knowledge fro |
| | university can used a first time for real engine | eering tasks. | | |
| Skille | Students of the different specialisations should | uld be integrated in typical day's wor | Ry this they are learning | ing typical tasks a |
| JKIIIS | functions of engineers. They are able to struct | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to cooperate with co-worker | rs in a company and to understand the | language of engineers. | |
| Autonomy | Students can finish own tasks. | | | |
| Autonomy | Students can inisi own tasks. | | | |
| Workload in Hours | Independent Study Time 512, Study Time in L | ecture 28 | | |
| Credit points | 18 | | | |
| Course achievement | None | None | | |
| Examination | Written elaboration (accord. to Internship Reg | ulations) | | |
| Examination duration and | see Internship Regulations | | | |
| scale | | | | |
| | | | | |
| Assignment for the | General Engineering Science (German program | n, 7 semester): Core Qualification: Con | npulsory | |

Course L2687: Advanced Intenship AIW/ ES: Internship-accompanying Seminar

| Тур | Seminar |
|-------------------|--|
| Hrs/wk | 1 |
| CP | 0 |
| Workload in Hours | Independent Study Time -14, Study Time in Lecture 14 |
| Lecturer | Prof. Robert Seifried, Eilika Schwenke |
| Language | DE/EN |
| Cycle | WiSe/SoSe |
| Content | The aim of the internship-accompanying seminar is the acquisition and consolidation of competences relevant for successfully doing the advanced internship in the 7th semester. The target group is students who already have found an internship placement. The focus is on strengthening personal competences to support the successful development of professional competences. In the seminar, students reflect on current challenges in relation to the internship. They discuss current topics with fellow students and teachers with the method of collegial counselling (peer-to-peer approach); in this way they gain (additional) self-confidence and increase their chances of successfully contributing in the internship, recognising and expressing their own wishes and needs in order to optimally use the internship for their own theory-practice transfer. The selection of topics is process-oriented and controlled by the group; the teachers provide impulses for reflection on certain topics. Topics that are dealt with are, for example: Negotiating the employment contract, Successful start into the internship - how do I behave in the first few days, How do I get interesting tasks, How do I deal with difficult situations (e.g. conflicts, sexism, racism), How do I note my progress/write the internship report? Through the internship sof their ports the acquisition and consolidation of competences in career management skills that can be transferred to later career steps. |
| Literature | |

| Course L2682: Advanced Inte | rnship AIW/ ES: Preparation |
|-----------------------------|---|
| Тур | Seminar |
| Hrs/wk | 1 |
| СР | 0 |
| Workload in Hours | Independent Study Time -14, Study Time in Lecture 14 |
| Lecturer | Prof. Robert Seifried, Eilika Schwenke |
| Language | DE/EN |
| Cycle | WiSe/SoSe |
| | The aim of the internship preparation (recommended in the 5th semester) is to acquire competences that are relevant for successfully searching for and doing the advanced internship in the 7th semester. Participation increases the students' chances of finding an internship of at least three months length and, if applicable, in English language, at the specified time. It also serves as a networking opportunity for the AIW/ES students. Participation in the 5th semester is recommended for a timely internship application. |
| | The seminar focuses on the topics of internship search, application and transfer competence. The students reflect on their already existing competences, skills and interests and learn which different employers are available for the engineering profession and how to find them. They continue to reflect on which topics of their studies they would like to try out in practical transfer in activities (theory-practice transfer) and look for suitable employers (if necessary under guidance). Contact is made with companies and other employers in the Hamburg metropolitan region who are potential employers for TUHH graduates. The students are supported in creating an appealing CV and cover letter. They practise presenting themselves in a job interview and complete a mock interview. They receive feedback from their fellow students and the teachers, gain self-confidence and increase their chances of finding an internship that is a good fit for them. |
| | The seminar strengthens the students' independence. The concrete application example of the advanced internship promotes the acquisition and consolidation of competences of career management skills, which can be transferred to later career steps. It also contributes to the interaction of theory and practice. Transfer in this context is "the successful application of previously acquired knowledge or skills in the context of a new requirement not yet apparent in the situation of knowledge or skill acquisition." Hasselhorn/Gold 2017 |
| Literature | |

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.

| - | | | | |
|---------------------------------------|---|---|--------------------|------------------------|
| 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 Materials (L02 | 1 | Lecture | 2 | 2 |
| | Prof. Frank Schmidt-Döhl | | | |
| Admission Requirements | | | | |
| | Knowledge of physics, chemistry and m | nathematics from school | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students | have reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are able to identify fundation | mental effects of action to materials and structures, to | explain different | t types of mechanic |
| | behaviour, to describe the structure | of building materials and the correlations between | structure and | other properties, |
| | show methods of joining and of corros | sion processes and to describe the most important re | egularities and p | properties of building |
| | materials and structures and their mea | surement in the field of protection against moisture, co | oldness, fire and | noise. |
| Chille | The students are able to work with the | a meet important standardized methods and regulariti | an in the field of | na alakuwa mwaka akia |
| SKIIIS | | e most important standardized methods and regulariti | | moisture protection |
| | the German regulation for energy saving | ng, fire protection and noise protection in the case of a | small building. | |
| Personal Competence | | | | |
| Social Competence | The students are able to support each o | other to learn the very extensive specialist knowledge. | | |
| | | | | |
| Autonomy | The students are able to make the timin | ng and the operation steps to learn the specialist know | ledge of a very e | extensive field. |
| | | | | |
| | | | | |
| Workload in Hours | Independent Study Time 96, Study Tim | e in Lecture 84 | | |
| Credit points | | | | |
| Course achievement | None | | | |
| | Written exam | | | |
| Examination duration and | 2 h written exam | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German | program, 7 semester): Specialisation Civil Engineering: | Compulsory | |
| Following Curricula | Civil- and Environmental Engineering: C | Core Qualification: Compulsory | | |
| | General Engineering Science (English p | rogram, 7 semester): Specialisation Civil Engineering: | Compulsory | |
| | Orientierungsstudium: Core Qualification | on: Elective Compulsory | | |
| | Technomathematics: Specialisation III | Engineering Science: Elective Compulsory | | |

| Course L0217: Building Phys | ics |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 E | Building Materials |
|-------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 |
| | Material testing |
| | Principles of metals |
| | Joining methods |
| Literature | Wendehorst, R.: Baustoffkunde. ISBN 3-8351-0132-3 |
| | Scholz, W.:Baustoffkenntnis. ISBN 3-8041-4197-8 |
| | |

| 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 | None | | | | |
| Recommended Previous | Mechanics I, Mather | matics I | | | |
| Knowledge | | | | | |
| Educational Objectives | After taking part suc | ccessfully, students have re | eached the following learning results | | |
| Professional Competence | | | | | |
| Knowledge | After successfully co | ompleting this module, stud | lents can express the basic aspects of line | ar frame analysis of | statically determina |
| | systems. | | | | |
| Skille | After successful con | polation of this module, th | e students are able to distinguish between | statically dotormina | ato and indotormina |
| JKIIIS | | | riables and to construct influence lines of | - | |
| | frame and truss stru | - | | statically acterinin | are plane and space |
| | | | | | |
| | | | | | |
| Personal Competence | | | | | |
| Social Competence | | | | | |
| | | | | | |
| | | subject-specific and interd | | | |
| | defend their own work results in front of others promote the scientific development of colleagues Furthermore, they can give and accept professional constructive criticism | | | | |
| | | | | | |
| | • Turthermore, | they can give and accept | | | |
| Autonomy | The students are able work in-term homework assignments. Due to the in-term feedback, they are enabled to self-assess the | | | | |
| | learning progress du | uring the lecture period, all | eady. | | |
| Workload in Hours | Independent Study | Time 124, Study Time in Le | ecture 56 | | |
| Credit points | 6 | | | | |
| Course achievement | Compulsory Bonus | Form | Description | | |
| | No 10 % | Written elaboration | Hausübungen mit Testat, betreut durc | h Studentische Tuto | oren (Tutorium) |
| Examination | Written exam | | | | |
| Examination duration and | 90 Minuten | | | | |
| scale | | | | | |
| Assignment for the | General Engineering | g Science (German progran | n, 7 semester): Specialisation Civil Enginee | ring: Compulsory | |
| Following Curricula | General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory | | | | |
| | Civil- and Environmental Engineering: Core Qualification: Compulsory | | | | |
| | Civil- and Environmental Engineering: Core Qualification: Compulsory | | | | |
| | | | , 7 semester): Specialisation Civil Engineer | ing: Compulsory | |
| | | | ering Science: Elective Compulsory | | |
| | rechnomathematics | s: specialisation III. Enginee | ring Science: Elective Compulsory | | |
| Course L0666: Structural An | alveie I | | | | |
| | Lecture | | | | |
| Typ Hrs/wk | 2 | | | | |
| Hrs/wk | ۷ | | | | |

| Тур | Lecture |
|-------------------|---|
| Hrs/wk | 2 |
| CP | 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 Ana | ourse L0667: Structural Analysis I | | |
|------------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| CP | 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 | | |

| Courses | | | | | | |
|-------------------------------------|--|--------------------|---------------------------|------------------------------------|---------------------|---------------------|
| Title | | | | Тур | Hrs/wk | СР |
| Building Materials and Building Che | emistry (L0248) | | | Lecture | 4 | 4 |
| Building Materials and Building Che | emistry (L0249) | | | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Frank Schmidt- | Döhl | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Module Principles of | Building Material | s and Building Physics | | | |
| Knowledge | | | | | | |
| Educational Objectives | After taking part suc | cessfully, student | ts have reached the foll | owing learning results | | |
| Professional Competence | | | | | | |
| Knowledge | The students are a | able to explain | the most important of | components, the manufacture | , the structure, | the most importa |
| | characteristics of the | e mechanical be | haviour and the corros | on behaviour, the material te | sting and the field | s of utilization of |
| | relevant building ma | terials. | | | | |
| | - | | | | | |
| | | | | | | |
| Skille | The students are al | blo to accoss the | o usability of building | matorials for different applica | tions and to solo | t building matori |
| SKIIIS | The students are able to assess the usability of building materials for different applications and to select building material according to their specific advantages and disadvantages. The students are able to prepare the mixture of a normal type concr | | | | | |
| | | - | - | | | |
| | | | | nd the connections between t | ne characteristic c | oncrete paramete |
| | They are able to sele | ect suitable mater | rials and mixtures to av | bid damage processes. | | |
| Personal Competence | | | | | | |
| Social Competence | The students are ab | le to support eac | h other to learn the ve | ry extensive specialist knowled | lae in learnina aro | ups and to carry o |
| | exercises in small gr | | | | 5 55 | |
| | , | | | | | |
| | | | | | | |
| Autonom | The students are abl | a ta malia tha tin | aina and the energtion (| tens to leave the energialist line | | utonoise field |
| Autonomy | The students are abi | e to make the tin | ning and the operation s | steps to learn the specialist kno | wiedge of a very e | extensive field. |
| Workload in Hours | Independent Study T | ime 110, Study T | Fime in Lecture 70 | | | |
| Credit points | 6 | | | | | |
| Course achievement | Compulsory Bonus | Form | Description | | | |
| | No 10 % | Presentation | | | | |
| Examination | Written exam | | | | | |
| Examination duration and | 2 h written exam | | | | | |
| scale | | | | | | |
| Assignment for the | General Engineering | Science (Germar | n program, 7 semester): | Specialisation Civil Engineerin | g: Compulsory | |
| - | | | : Core Qualification: Con | | _ ,, | |
| | | | | Specialisation Civil Engineering | : Compulsory | |
| | | | | | | |

| Course L0248: Building Mate | rials and Building Chemistry |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 4 |
| CP | 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 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Frank Schmidt-Döhl, Andre Rössler | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| ourses | | | | | | |
|--|---|---------------------------|--|-------------------------|----------------------|--|
| itle | | | Тур | Hrs/wk | СР | |
| roject Seminar Concrete I (L0896) | | | Seminar | 1 | 1 | |
| Reinforced Concrete Design I (L030 | 3) | | Lecture | 2 | 3 | |
| Reinforced Concrete Design I (L030 | 15) | | Recitation Section (large | 2 | 2 | |
| Module Responsible | Prof. Günter Romba | ch | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Basic knowledge in | structural analysis and | l building materials. | | | |
| Knowledge | Modules: Structura | l Analysis I, Mechanics | 1+11 | | | |
| Educational Objectives | After taking part su | ccessfully, students ha | ve reached the following learning results | | | |
| Professional Competence | | | | | | |
| Knowledge | The students can ou | utline the history of co | ncrete construction and explain the basics of | structural engineering | , including usual lo | |
| | combinations and s | afety concepts. They a | are able to draft and dimension simple struct | ures, as well as to eva | luate and discuss | |
| | behaviour of the ma | aterials and of structura | al members. | | | |
| | | | | | | |
| Skills The students are able to apply basic procedures of the conception and dimensioning to p | | | | | | |
| | simple concrete structures and to design them for bending and bending with axial force, and to plan their detailing and | | | | | |
| | execution. Moreove | r, they can make desig | in and construction sketches and draw up tec | hnical descriptions. | | |
| Personal Competence | | | | | | |
| Social Competence | | | | | | |
| Autonomy | The students are able to carry out simple tasks in the conception and dimensioning of structures and to critically reflect the result | | | | | |
| Workload in Hours | Independent Study | Time 110, Study Time | in Lecture 70 | | | |
| Credit points | | | | | | |
| Course achievement | Compulsory Bonus | Form | Description | | | |
| | Yes None | Excercises | | | | |
| Examination | Written exam | | | | | |
| Examination duration and | 120 minutes | | | | | |
| scale | | | | | | |
| Assignment for the | General Engineering | g Science (German pro | gram, 7 semester): Specialisation Civil Engine | ering: Compulsory | | |
| Following Curricula | Civil- and Environm | ental Engineering: Core | e Qualification: Compulsory | | | |
| | 1 | | | | | |

| Course L0896: Project Semin | | |
|-----------------------------|--|--|
| Тур | Seminar | |
| Hrs/wk | 1 | |
| CP | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dr. Björn Schütte | |
| Language | | |
| 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 Co | ncrete Design I |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Günter Rombach |
| Language | DE |
| Cycle | SoSe |
| Content | The following subjects/contents are treated: |
| Literature | history of concrete construction building materials: mechanical and physical-chemical properties of concrete, steel, GFRP, CFRP Introduction in safety concepts, ultimate limit states and safety coefficients actions on structures design of linear concrete members with arbitrary cross section for tension and bending with/without axial force design of slender columns Download der Unterlagen zur Vorlesung über Stud.IP! Zilch K., Zehetmaier G.: Bemessung im konstruktiven Betonbau. Springer Verlag, 2010 König G., Tue N.: Grundlagen des Stahlbetonbaus, 3. Auflage, Teubner-Verlag, 2008 Deutscher Beton- und Bautechnikverein E.V.: Beispiele zur Bemessung von Betontragwerken nach Eurocode 2. Band 1: Hochbau, Bauverlag GmbH, Wiesbaden 2011 Fingerlos F., Hegger J., Zilch K.: Eurocode 2 für Deutschland. Berlin 2016 |
| | 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 |

| 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 | |

| Module M0744: Struc | tural Analysis II | | | | | |
|--|---|----------------------|---------------------------|-------------------------|--------------------|---------------------|
| Courses | | | | | | |
| Title | | | Тур | | Hrs/wk | СР |
| Structural Analysis II (L0673) | | | Lectur | | 2 | 3 |
| Structural Analysis II (L0674) | | | Recita | tion Section (large) | 2 | 3 |
| Module Responsible | Prof. Uwe Starossek | | | | | |
| Admission Requirements Recommended Previous | None | | | | | |
| Knowledge | Mechanics I/II | | | | | |
| | Mathematics I/II | | | | | |
| | Differential Equations I Structural Analysis I | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Educational Objectives | After taking part successfully, | , students have re | ached the following lear | ning results | | |
| Professional Competence | | | | | | |
| Knowledge | After successful completion | of this module, | students can express | the basic aspects of | of linear frame a | nalysis of statica |
| | indeterminate systems. | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Skille | After successful completion (| of this module th | e students are able to | analyze state variable | es and to constru | ct influence lines |
| Skills | statically inderminate plane a | | | | | ct initidence inies |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Personal Competence | | | | | | |
| Social Competence | Students can | | | | | |
| | | | | | | |
| | participate in subject-s defend their own work | | | | | |
| | promote the scientific | | | | | |
| | Furthermore, they can | | | criticism | | |
| Autonomi | The students are able to your | li in torra horsoura | ul acciente Due te | the is taken feedback | they are enchied | d to colf cocces th |
| Autonomy | The students are able to wor learning progress during the l | | | the in-term reedback | , they are enabled | a to sen-assess th |
| | rearing progress during the | lecture period, une | cuuy. | | | |
| | | | | | | |
| Workload in Hours | Independent Study Time 124, | , Study Time in Le | cture 56 | | | |
| Credit points | 6 | | | | | |
| Course achievement | Compulsory Bonus Form | n elebersti | Description | antat haturut dunit C | hudenbiech - Tot | en (Tuterium) |
| Examination | | n elaboration | nausubungen mit Te | estat, betreut durch S | ludentische Tutor | en (Tutorium) |
| Examination Examination duration and | 90 Minuten | | | | | |
| scale | | | | | | |
| Assignment for the | General Engineering Science | (German program | , 7 semester): Specialisa | ation Civil Engineering | : Compulsory | |
| Following Curricula | Civil- and Environmental Engi | neering: Core Qua | lification: Compulsory | | | |
| | General Engineering Science | (English program, | 7 semester): Specialisat | tion Civil Engineering: | Compulsory | |
| | | | | | | |
| Course L0673: Structural An | | | | | | |
| Тур | Lecture | | | | | |
| Hrs/wk | | | | | | |
| CP Workload in Hours | 3 Independent Study Time 62, 5 | Study Time in Last | ure 28 | | | |
| | Prof. Uwe Starossek | Judy Time In Lect | .ure 20 | | | |
| Language | | | | | | |
| Cuclo | | | | | | |

| Laliguage | |
|------------|---|
| 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 Ana | ourse L0674: Structural Analysis II | | |
|------------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| CP | 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 | | |

| Module M0706: Geote | echnics I | | | |
|-------------------------------------|---|---|-----------------|-----------------------|
| | | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Soil Mechanics (L0550) | | Lecture | 2 | 2 |
| Soil Mechanics (L0551) | | Recitation Section (large) | 2 | 2 |
| Soil Mechanics (L1493) | 1 | Recitation Section (small) | 2 | 2 |
| Module Responsible | Prof. Jürgen Grabe | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Modules : | | | |
| Knowledge | Mechanics I-II | | | |
| Educational Objectives | After taking part successfully, students | have reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students know the basics of soil mechanics as the structure and characteristics of soil, stress distribution due to weight, wate | | | |
| | or structures, consolidation and settlement calculations, as well as failure of the soil due to ground- or slope failure. After the successful completion of the module the students should be able to describe the mechanical properties and to evalu them with the help of geotechnical standard tests. They can calculate stresses and deformation in the soils due to weigh | | | ailure. |
| Skills | | | | rties and to evaluate |
| | | | | oils due to weight |
| | influence of structures. They are are ab | le to prove the usability (settlements) for shallow f | oundations. | |
| Deveral Competence | | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | Independent Study Time 96, Study Tim | a in Lastura 94 | | |
| | | e in Lecture 84 | | |
| Credit points Course achievement | | Description | | |
| Course achievement | No 20 % Attestation | Description | | |
| Examination | Written exam | | | |
| Examination duration and | 60 minutes | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German | program, 7 semester): Specialisation Civil Engineer | ina: Compulsory | |
| - | | program, 7 semester): Specialisation Civil Engineer | | |
| | Civil- and Environmental Engineering: C | | 5 | |
| | Civil- and Environmental Engineering: C | | | |
| | | rogram, 7 semester): Specialisation Civil Engineeri | ng: Compulsory | |
| | 5 5 . 5 1 | Engineering Science: Elective Compulsory | | |
| | | Engineering Science: Elective Compulsory | | |

| Course L0550: Soil Mechanic | S |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Jürgen Grabe |
| Language | DE |
| Cycle | WiSe/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 |

| ourse 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 | WiSe/SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |
| | |

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

| 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 | None | | | |
| Recommended Previous | | | | |
| Knowledge | Structural analysis I, Structural analysis II | | | |
| | Mechanics I, Mechanics II Duilding Materials and Building Chamintan | | | |
| | Building Materials and Building Chemistry | | | |
| | Principles of Building Materials and Buildir | ig Physics | | |
| Educational Objectives | After taking part successfully, students have rea | ched the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After passing this module students are able to | | | |
| | give a summary of the security concept | | | |
| | explain the priciples of the design process | | | |
| | describe and illustrate the bhaviour of me | | | |
| <i>ci 11</i> | | | | |
| SKIIIS | Students can rate and apply the material steel appropiately with respect to its properties and usage. | | | |
| | They can use the security concept with respect t | o loads, forces and resistances. | | |
| | They can check the ultimate limit state and the | serviceability of simple members in tension, | compression and | bending. |
| Personal Competence | | | | |
| Social Competence | After participation of an optional course (building | g of a simple truss) they are able to organi | ze themselves in | groups. They will |
| | successful in guided building a truss with bolted | connections according to design drawings. | | |
| Autonomy | | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lec | ture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 minutes | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, | 7 semester): Specialisation Civil Engineering | : Compulsory | |
| Following Curricula | Civil- and Environmental Engineering: Core Qual | ification: Compulsory | | |
| | General Engineering Science (English program, 7 | r semester): Specialisation Civil Engineering: | Compulsory | |
| | | | | |
| Course L0299: Steel Structu | res I | | | |
| Тур | Lecture | | | |
| Hrs/wk | 2 | | | |
| CP | 3 | | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lectu | ıre 28 | | |
| | | | | |

| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
|-------------------|---|--|
| Lecturer | rof. Marcus Rutner | |
| Language | | |
| 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 Structur | ourse L0300: Steel Structures I | | |
|------------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| CP | 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 | | |

| Courses | | | |
|--|--|--------------------------------|--|
| Fitle | Тур | Hrs/wk | СР |
| Applied Structural Dynamics (L079) | | 2 | 2 |
| Soil Laboratory Course (L0499) | Practical Course | 1 | 2 |
| Building Information Modeling (L190 | | 1 | 1 |
| Building Information Modeling (L190 | | 2 | 2 |
| Computational Analysis of Structure | | 2 | 3 |
| ntroduction in Statitics with R (L02 | | 1 | 1 |
| ntroduction in Statitics with R (L07 | - | 1 | 1 |
| rinciples of Geomatics (L0470) | Lecture | 2 | 2 |
| rinciples of Geomatics (L0471) | Recitation Section (small) | 2 | 2 |
| lumeric 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 |
| Special topics of Civil- and Environn | | 1 | 1 |
| Special topics of Civil- and Environn | nental Engineering 2 LP (L2412) | 2 | 2 |
| Special topics of Civil- and Environn | nental Engineering 3LP (L2413) | 3 | 3 |
| ire Protection and Prevention (L04 | 72) Lecture | 2 | 2 |
| Module Responsible | Prof. Peter Fröhle | | |
| Admission Requirements | None | | |
| Recommended Previous | none | | |
| Knowledge | | | |
| Educational Objection | | | |
| Educational Objectives | After taking part successfully, students have reached the following learning results | | |
| Educational Objectives Professional Competence | After taking part successfully, students have reached the following learning results | | |
| Professional Competence | After taking part successfully, students have reached the following learning results The students are at home doing with typical applications of the study programme. | | |
| Professional Competence Knowledge | | stions. They a | re able to work in |
| Professional Competence Knowledge Skills Personal Competence | The students are at home doing with typical applications of the study programme. The students are able to use the methods that are provided during the lectures for practical ques learnt methods into new forms of application independently". | | |
| Professional Competence Knowledge Skills Personal Competence | The students are able to use the methods that are provided during the lectures for practical ques | | |
| Professional Competence Knowledge Skills Personal Competence Social Competence | The students are at home doing with typical applications of the study programme. The students are able to use the methods that are provided during the lectures for practical ques learnt methods into new forms of application independently". According to the course chosen students are able to perform tasks or to conduct a project i | n teams. If s | o, they can prese |
| Professional Competence Knowledge Skills Personal Competence Social Competence Autonomy | The students are at home doing with typical applications of the study programme. The students are able to use the methods that are provided during the lectures for practical ques learnt methods into new forms of application independently". According to the course chosen students are able to perform tasks or to conduct a project i discuss and document results accordingly. | n teams. If s | o, they can prese |
| Professional Competence Knowledge Skills Personal Competence Social Competence Autonomy | The students are at home doing with typical applications of the study programme. The students are able to use the methods that are provided during the lectures for practical quess learnt methods into new forms of application independently". According to the course chosen students are able to perform tasks or to conduct a project i discuss and document results accordingly. According to the course chosen individual students can plan and document tasks and work flow f Depends on choice of courses | n teams. If s | o, they can pres |
| Professional Competence Knowledge Skills Personal Competence Social Competence Autonomy Workload in Hours Credit points | The students are at home doing with typical applications of the study programme. The students are able to use the methods that are provided during the lectures for practical quess learnt methods into new forms of application independently". According to the course chosen students are able to perform tasks or to conduct a project i discuss and document results accordingly. According to the course chosen individual students can plan and document tasks and work flow f Depends on choice of courses | n teams. If s for themselve | o, they can pres s or for the team. |

| Course L0791: Applied Struc | tural 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 | 15 min |
| scale | |
| | Dr. Kira Holtzendorff |
| Language | |
| Cycle | WiSe |
| | The lecture gives an introduction into the classical structural dynamics, whereas the focus lies on the practical applications. The theoretical basics are worked out in order to apply them for typical issues in practice. For an effective vibration isolation due to vibration excitations by e.g. railway traffic, operating machines oder moving people, different structural measures are presented. The lecture is completed by performing examples of vibration measurements as well as interactive dynamic experiments in the laboratory. The following topics are covered: Particular features in structural dynamics Basic terms of time-dependent excitations Free vibrations (natural frequencies) Induced vibrations 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 L0499: Soil Laborator | ry Course |
|------------------------------|---|
| Тур | Practical Course |
| Hrs/wk | 1 |
| CP | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Examination Form | Schriftliche Ausarbeitung |
| Examination duration and | Die gesamte Arbeitszeit im Praktikum plus anschließender Bericht = 90 Stunden Arbeitszeit (Das Erstellen der Ausarbeitung = |
| scale | Bearbeitungszeitraum von 4 Wochen und ein Umfang von maximal 50 Seiten.) |
| Lecturer | Prof. Jürgen Grabe |
| Language | DE |
| Cycle | WiSe |
| Content | Field experiments |
| | Short lecture on laboratory tests |
| | soil analysis |
| | laboratory test |
| | soil clasification |
| | Creating a ground and foundation report |
| Literature | DIN-Taschenbuch 113, Erkundung und Untersuchung des Baugrundes |
| | |

| Course L1903: Building Inform | nation 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 | siehe Modulhandbuch |
| scale | |
| Lecturer | Prof. Kay Smarsly |
| Language | DE |
| Cycle | WiSe/SoSe |
| Content | Basic knowledge of Building Information Modeling: |
| | Introduction to BIM (development, backgrounds, history, opportunities, risks, levels) |
| | Current standards and guidelines (national and international standardisation, structures) |
| | Applications of BIM (openBIM, closedBIM, littleBIM, data and interchange formats) |
| | Object oriented modeling (requirements, structure, classification, parts catalogues) |
| | BIM-Implementation (structures, cycles, professions, job profiles, execution plan) |
| | BIM-Tools (software, hardware, application areas) |
| | Execution examples (national and international construction projects) |
| | Basic knowledge for the use of the software Allplan 2018: |
| | Basic settings (project administration, building structures, fileset structures, layers) |
| | Construction fundamentals 2D (e. g. line, circle, spline, ellipse, parallel etc.) |
| | Modifying of construction elements (e. g. copy, mirror, intersect, fillet etc.) |
| | Dimensioning and text adding of designed elements and structural components |
| | Generating of areas (hatchings, patterns, fills) |
| | Construction fundamentals 3D (floor concept, floor manager, building structures) |
| | Walls and columns (height definitions, parameters, attributes, format properties) |
| | Slabs (height definitions, parameters, attributes, format properties) |
| | Use of libraries (u. a. furnitures, surroundings etc.) |
| | Opening Elements and SmartParts (doors and windows) |
| | Stairs and ramps (stair wizard, IFC-Ramp) |
| | Roof frame and roof covering (custom planes, parameters, attributes, format properties) |
| | Attributes and characteristic values (allocations and modifications) |
| | Export and Import of IFC-Data (basics, floor allocation, fileset selection) |
| | Generating of sections and views (architecturial sections and associative sections) |
| | Generating of printable drawings (layouts, scales, page settings) |
| Literature | • |

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

| Course L0370: Computationa | Il Analysis of Structures |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Examination Form | Klausur |
| Examination duration and | 60 min |
| scale | |
| 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 | Vorlesungsunterlagen können im STUDiP heruntergeladen werden 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) |

| Course L0286: Introduction i | n Statitics with R |
|------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 1 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | Klausur |
| Examination duration and | 60 min |
| scale | |
| Lecturer | Dr. Joachim Behrendt |
| Language | DE |
| Cycle | WiSe |
| Content | Introduction to R |
| | Graphics with R |
| | Descriptive Statistic (Boxplot, Percentiles, outliers) |
| | Propability (Combinatorics, relative frequency, dependand probability) |
| | random numbers and distibutions (confidence interval, uniform and discrete distributions, test-distributions (t-F-X ² -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) |
| Literature | Regionales Rechenzentrum für Niedersachsen |
| | Statistik mit R |
| | Grundlagen der Datenanalyse |
| | , 2013 |
| | Einführung in die Statistik mit R, Andreas Handl, Skript Uni Bielefeld |
| | http://www.wiwi.uni-bielefeld.de/fileadmin/emeriti/frohn/handl_grundausbildung/statskript.pdf |
| | 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.r-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 | Klausur |
| Examination duration and | siehe Vorlesung |
| scale | |
| Lecturer | Dr. Joachim Behrendt |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L0470: Principles of | Geomatics |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Examination Form | Schriftliche Ausarbeitung |
| Examination duration and | schriftliche Ausarbeitungen zu allen fünf Übungen, ggf. Testklausur |
| scale | |
| Lecturer | Dr. Annette Scheider |
| 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: Principles of Geomatics | |
|---------------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Examination Form | Schriftliche Ausarbeitung |
| Examination duration and | |
| scale | |
| Lecturer | Dr. Annette Scheider |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L0125: Numeric and I | |
|-----------------------------|---|
| | |
| 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 | 5 Übungsaufgaben jeweils mit Testat am Ende |
| scale | |
| Lecturer | Dr. Stefan Benders, Prof. Siegfried Rump |
| 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): Moler, C., Numerical Computing with MATLAB, SIAM, 2004 The Math Works, Inc. , MATLAB: The Language of Technical Computing, 2007 Rump, S. M., INTLAB: Interval Labority, http://www.ti3.tu-harburg.de 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 |
| Examination Form | Fachtheoretisch-fachpraktische Arbeit |
| Examination duration and | 6 Versuchsprotokolle |
| scale | |
| Lecturer | Dr. Klaus Johannsen |
| Language | DE |
| Cycle | WiSe |
| Content | !Max.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 and presentations |
| | 5. Day: Evaluation of the protocols and presentations, final discussion |
| 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 | Referat |
| Examination duration and | ca. zehnminütige Präsentation |
| scale | |
| Lecturer | Prof. Jürgen Grabe |
| Language | DE |
| Cycle | SoSe |
| Content | Excursions to different construction and enviromental projects. |
| Literature | keine |

| ourse L2411: Special topics of Civil- and Environmental Engineering | | |
|---|---|--|
| Тур | | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Examination Form | laut FSPO | |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt | |
| scale | | |
| Lecturer | Dozenten des SD B | |
| Language | DE/EN | |
| Cycle | WiSe/SoSe | |
| Content | The course occurs only if required. The content is defined at short notice. | |
| Literature | Die Literatur wird kurzfristig festgelegt. | |

| Course L2412: Special topics of Civil- and Environmental Engineering 2 LP | | |
|---|---|--|
| Тур | | |
| Hrs/wk | 2 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Examination Form | laut FSPO | |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt | |
| scale | | |
| Lecturer | Dozenten des SD B | |
| Language | DE/EN | |
| Cycle | WiSe/SoSe | |
| Content | The course occurs only if required. The content is defined at short notice. | |
| Literature | Die Literatur wird kurzfristig festgelegt. | |

| Course L2413: Special topics of Civil- and Environmental Engineering 3LP | |
|--|---|
| Тур | |
| Hrs/wk | 3 |
| CP | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Examination Form | laut FSPO |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt |
| scale | |
| Lecturer | Shahin Daniel Fassih, Dozenten des SD B |
| Language | DE/EN |
| Cycle | WiSe/SoSe |
| Content | The course occurs only if required. The content is defined at short notice. |
| Literature | Die Literatur wird kurzfristig festgelegt. |

| Course L0472: Fire Protection and Prevention | | |
|--|--|--|
| 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 | 20 min | |
| scale | | |
| Lecturer | Philipp Below, Ulrich Körner | |
| 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 | |

| Courses | | | | | | | |
|--------------------------|--|--|----------------------------|-----------------------|-----------------------------------|----------------------|----------------------|
| Title | | | | | Tun | Hrs/wk | CP |
| Hydrology (L0909) | | | | | Typ Lecture | пт 5/ wк 1 | 1 |
| Hydrology (L0956) | | | | | Project-/problem-based Learning | 1 | 2 |
| Hydromechanics (L0615) | | | | | Lecture | 2 | 2 |
| Hydromechanics (L0616) | | | | | Project-/problem-based Learning | 1 | 1 |
| Module Responsible | Prof. Peter Fr | öhle | | | | | |
| Admission Requirements | None | | | | | | |
| Recommended Previous | Mathematics | I, II and II | 1 | | | | |
| Knowledge | | | | | | | |
| | Mechanics I u | und II | | | | | |
| Educational Objectives | After taking p | oart succe | ssfully, students have r | eached the following | g learning results | | |
| Professional Competence | | | | | | | |
| Knowledge | The students | are able | to define the basic ter | ms of hvdromecha | nics, hydrology groundwater h | vdrology and | water manageme |
| 2 | | | | | ii) kinematics of flows and iii) | | |
| | - | | | | cycle. Besides, the students | | |
| | | | | | models as well as the concep | | |
| | hydrograph. | | 5 | | | | |
| | J 5 - 1- | | | | | | |
| Skills | The students | are able | to apply the fundament | al formulations of hy | ydromechanics to basic practic | al problems. F | urthermore, they a |
| | able to run, explain and document basic hydraulic experiments. | | | | | | |
| | Posidos, they are able to apply basis by dralogical approaches and mathede to simple by dralogical methods. The students have | | | | | | |
| | Besides, they are able to apply basic hydrological approaches and methods to simple hydrological problems. The students hav | | | | | | |
| | 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 de | | | | can be descri | bed and the studer | |
| | are able to perform, analyze and assess respective measurements. | | | | | | |
| Personal Competence | | | | | | | |
| - | | | | | | | |
| Social Competence | The students are able to work in groups in a goal-orientated, structured manner. They can explain their results sustainably plenary sessions by use of peer learning approaches. Furthermore, they are able to prepare and present technical presentation | | | | | | |
| | | | | loaches. Turthennoi | | iu present tet | |
| | for given topi | ics in grou | ips. | | | | |
| Autonomy | Students are | capable o | of organising their indivi | dual work flow to co | ontribute to the conduct of exp | eriments and | to present disciplir |
| | specific know | vledge. Th | ney can provide each o | ther with feedback | and suggestions on their resu | lts. They are | capable of reflecti |
| | specific knowledge. They can provide each other with feedback and suggestions on their results. They are capable of re their study techniques and learning strategy on an individual basis. | | | | | | |
| Workload in Hours | Indonondont | Independent Study Time 110, Study Time in Lecture 70 | | | | | |
| Credit points | | Study III | ie 110, Study fille if E | | | | |
| Course achievement | Compulsory B | onus | Form | Description | | | |
| | Yes N | lone | Group discussion | Erstellung eir | ne Posters zu einer Themat | tik aus dem | Themengebiet o |
| | | | | Hydrologie in (| Gruppen und Präsentation | | - |
| | Yes N | lone | Excercises | Übungsaufgab | en Hydrologie | | |
| | | lone | Subject theoretical | | Dokumentation und Prä | sentation zu | ı einem Versuc |
| | | | practical work | | ik oder Hydraulik in Gruppen | | |
| Examination | Written exam | า | | | | | |
| Examination duration and | 150 minutes | | | | | | |
| scale | | | | | | | |
| Assignment for the | General Engi | neering S | cience (German prograr | n, 7 semester): Spe | cialisation Civil Engineering: Co | ompulsory | |
| Following Curricula | Civil- and Env | vironment | al Engineering: Core Qu | alification: Compuls | sory | | |
| | General Engi | neering S | cience (English program | , 7 semester): Spec | ialisation Civil Engineering: Co | mpulsory | |
| | Logistics and | Mobility: | Specialisation Traffic Pla | anning and Systems | Elective Compulsory | | |
| | - | - | gement - Major in Logisl | | | | |

| Course L0909: Hydrology | |
|-------------------------|---|
| Тур | Lecture |
| Hrs/wk | 1 |
| CP | 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 and groundwater hydrology: Hydrological cycle Data acquisition in hydrology Data analyses and statistical assessment Statistics of extremes Regionalization methods for hydrological values rainfall-run-off modelling on the basis of a unit hydrograph concept |
| Literature | Maniak, U. (2017). Hydrologie und Wasserwirtschaft: Eine Einführung für Ingenieure. Springer Vieweg. Skript "Hydrologie und Gewässerkunde" |

| Course L0956: Hydrology | |
|-------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 1 |
| CP | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Peter Fröhle |
| Language | DE |
| Cycle | WiSe |
| Content | Introduction to basics of Hydrology: • Hydrological cycle • Data acquisition • Data analyses and statistical assessment • Statistics of extremes • Regionalization methods for hydrological values Rainfall-run-off modelling on the basis of a unit hydrograph conceps |
| Literature | Maniak, Hydrologie und Wasserwirtschaft, Eine Einführung für Ingenieure, Springer Skript Hydrologie und Gewässerkunde |

| Courses LOCIE: Understress | |
|----------------------------|---|
| Course L0615: Hydromechan | |
| | 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 | Fundamentals of Hydromechanics |
| | 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: Hydromechan | Irse L0616: Hydromechanics | | |
|---------------------------|---|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 1 | | |
| CP | 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 | | |

| Module M0755: Geote | chnics II | | | | | |
|--------------------------------|--|----------------------|----------------------------|---------------------------------|--------------------|----------------|
| | | | | | | |
| Courses | | | | | | |
| Title | | | | Тур | Hrs/wk | СР |
| Foundation Engineering (L0552) | | | | Lecture | 2 | 2 |
| Foundation Engineering (L0553) | | | | Recitation Section (large) | 2 | 2 |
| Foundation Engineering (L1494) | | | | Recitation Section (small) | 2 | 2 |
| - | Prof. Jürgen Grabe | | | | | |
| • | None | | | | | |
| | Modules: | | | | | |
| Knowledge | Mechanics I-II | | | | | |
| | Geotechnics I | | | | | |
| | • Geotechnics i | | | | | |
| | | | | | | |
| Educational Objectives | After taking part succ | ossfully students | have reached the follow | ing loarning rocults | | |
| Professional Competence | Anter taking part succe | essiuny, students | | ing learning results | | |
| - | The students know the | o basis principlos | and mothods which are | required to verificate the stab | ility of gootochni | cal structures |
| - | 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: | | | | | |
| SKIIIS | After successful comp | letion of the modi | lie the students are able | e to: | | |
| | verificate the st | tability and usabili | ty of foundations, | | | |
| | know individual | l methods of groui | nd improvement and ap | ply them in their range of app | lication, | |
| | design retaining walls. | | | | | |
| | | | | | | |
| Personal Competence | | | | | | |
| Social Competence | | | | | | |
| Autonomy | | | | | | |
| Workload in Hours | Independent Study Tir | me 96, Study Time | e in Lecture 84 | | | |
| Credit points | 6 | | | | | |
| Course achievement | Compulsory Bonus | Form | Description | | | |
| | No 20 % | Attestation | | | | |
| | Written exam | | | | | |
| Examination duration and | 60 minutes | | | | | |
| scale | | | | | | |
| Assignment for the | General Engineering S | cience (German p | rogram, 7 semester): S | pecialisation Civil Engineering | : Elective Compul | lsory |
| Following Curricula | General Engineering S | cience (German p | rogram, 7 semester): S | pecialisation Civil Engineering | : Elective Compul | lsory |
| | Civil- and Environmen | tal Engineering: C | ore Qualification: Comp | ulsory | | |
| | Civil- and Environmen | tal Engineering: S | pecialisation Civil Engine | eering: Compulsory | | |
| | Civil- and Environmen | tal Engineering: S | pecialisation Traffic and | Mobility: Elective Compulsory | / | |
| | Civil- and Environmen | tal Engineering: S | pecialisation Water and | Environment: Elective Compu | llsory | |
| | General Engineering S | cience (English p | ogram, 7 semester): Sp | ecialisation Civil Engineering: | Elective Compuls | sory |
| | Technomathematics: | Consisting III. | | ative Commuterer | | |

| Course L0552: Foundation E | ngineering |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Jürgen Grabe |
| Language | DE |
| Cycle | WiSe/SoSe |
| 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 |

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

| Courses | | | | | | |
|--|--|----------------------------------|----------------|--------------|--|--|
| Title | т | Гур | Hrs/wk | СР | | |
| Basics in Structural Design (L0209) | | Project-/problem-based Learning | 2 | 4 | | |
| Basics of Structural Design (L0205) | | ecture | 2 | 1 | | |
| Basics in Structural Design (L0208) | | Recitation Section (large) | T | I | | |
| Module Responsible Admission Requirements | | | | | | |
| | Contents of module "Principles of Building Materials and Building P | hysics" | | | | |
| Knowledge | contents of module remitiples of building materials and building r | Trysics | | | | |
| | After taking part successfully, students have reached the following | learning results | | | | |
| Professional Competence | Frich taking part successionly, statistics have reached the following | learning results | | | | |
| | After attending the "Building Construction" module students are at | ble | | | | |
| hitelige | | | | | | |
| | to define the basics of building regulations law | | | | | |
| | to explain load effects and associated concepts | | | | | |
| | to describe overriding conventions of the construction indus | try | | | | |
| | to specify typical building components | | | | | |
| | to distinguish between different possibilities of load bearing | behaviour and risks due to lac | k of stability | | | |
| | to explain the main objectivs of fire control. | | | | | |
| Skills | After the successful completion of the "Building Construction" module, students will be able | | | | | |
| | to apply industry-specific drawing conventions | | | | | |
| | carry out preliminary dimensioning of basic building comport | hents | | | | |
| | develop stability and foundation concepts | | | | | |
| use BIM software | | | | | | |
| | and to design and construct standard cross-sections due to | structural aspects. | | | | |
| Personal 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 | | | | | |
| | to give a feedback to other students in a constructive mann | er | | | | |
| Autonomy | After attending the course students are able | | | | | |
| | to control and improve their knowledge with the help of wee | ekly presentations (lecture roc | om) and tests | (STUD.IP) | | |
| | to divide the main task in different parts, to deduce the nee | | | | | |
| | - to arvice the main task in difference parts, to deduce the nee | aca knowledge and to selledal | e the unteren | e work steps | | |
| | | | | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | | | |
| Credit points | | | | | | |
| Course achievement | None | | | | | |
| Examination | Subject theoretical and practical work | | | | | |
| Examination duration and | Desing, Construction and prelimnary design in a written form | | | | | |
| scale | | | | | | |
| Assignment for the | General Engineering Science (German program, 7 semester): Spec | ialisation Civil Engineering: Co | mpulsory | | | |
| Following Curricula | Civil- and Environmental Engineering: Core Qualification: Compulse | ory | | | | |
| | General Engineering Science (English program, 7 semester): Speci | alisation Civil Engineering: Cor | nnulsory | | | |

| ourse L0209: Basics in Stru | ctural Design |
|-----------------------------|---|
| | |
| Тур | Project-/problem-based Learning |
| Hrs/wk | |
| CP | |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Sebastian Rybczynski |
| Language | DE |
| Cycle | WiSe |
| Content | Constructing a small individual building in groups of 4 percent. |
| | 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 functionality (sealing, facades, roofs) |
| | Design of building components and approving of the component interconnections |
| | Proofing and assessing of moisture behaviour, energy comsumption, acoustic protection and fire control |
| | Assessing the building stability |
| | Basics of building services |
| | Each week the results of different work steps are presented in oral and written form |
| | Lach week the results of unrefer work steps are presented in oral and written form |
| Literature | Vortragsfolien der Lehrveranstaltung stehen über STUD. IP zum download zur Verfügung |
| | |
| | |
| | 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 |
| | Norford Frank (City Laborator) |
| | Neufert, Ernst (Kister, Johannes) |
| | Bauentwurfslehre : Grundlagen, Normen, Vorschriften über Anlage, Bau, Gestaltung, Raumbedarf, Raumbeziehungen, Maße fü |
| | Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Maß und Ziel ; Handbuch für den Baufachmann, Bauherrr |
| | Lehrenden und Lernenden |
| | ISBN: 978-3-8348-0732-8 (GB.) |
| | Wiesbaden : Vieweg + Teubner, 2009 |
| | |

| Course L0205: Basics of Stru | ctural Design |
|------------------------------|---|
| Тур | |
| Hrs/wk | |
| CP | |
| | |
| | Independent Study Time 2, Study Time in Lecture 28 |
| | Sebastian Rybczynski |
| Language | |
| Cycle | Wise |
| 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 | Vortragsfolien der Lehrveranstaltung stehen über STUD.IP zum download zur Verfügung |
| | |
| | Schneider Bautabellen (Hrsg. A. Albert) |
| | 23., überarbeitete Aufl. |
| | ISBN 978-3-8462-0880-9 |
| | Reguvis Fachmedien GmbH, 2018 |
| | Neumann, Dietrich (Hestermann, U.; Rongen, L.; Weinbrenner, U.) |
| | Frick/Knöll Baukonstructionslehre 1 / [Internet-Ressource] |
| | ISBN: 978-3-8351-9121-1 |
| | Wiesbaden: Vieweg+Teubner Verlag, 2006 |
| | Frick, Otto (Knöll, K.; Neumann, D.; Hestermann, U.; Rongen, L.) |
| | Baukonstruktionslehre 2 / [Internet-Ressource] |
| | ISBN: 978-3-8348-9486-1 |
| | Wiesbaden: Vieweg+Teubner Verlag, 2008 |
| | |
| | Dierks, Klaus (Wormuth, R.) |
| | Baukonstruktion |
| | ISBN: 978-3-8041-5045-4 |
| | Neuwied : Werner, 2007 |
| | Neufert, Ernst (Kister, J.) |
| | Bauentwurfslehre (42. Aufl.) |
| | ISBN: 978-3-8348-0732-8 |
| | Wiesbaden : Vieweg + Teubner, 2018 |
| | |
| | Wendehorst, Reinhard (Wetzell, O. W.,; Baumgartner, H.,) |
| | Wendehorst Bautechnische Zahlentafeln |
| | ISBN: 978-3-8351-0055-8 |
| | Stuttgart/Berlin: Teubner/Beuth, 2018 |
| | |

| rse L0208: Basics in Struc | ctural Design |
|----------------------------|---|
| | Recitation Section (large) |
| Hrs/wk | |
| | |
| СР | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Sebastian Rybczynski |
| Language | DE |
| Cycle | WiSe |
| Content | Constructing a small individual building in groups of 4 percents |
| | 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 functionality (sealing, facades, roofs) Design and express of the functionality of the component interconnections |
| | Design and approve of the functionality of the component interconnections Design and approve af maintum behaviour approximation accustic protection and five control |
| | Proofing and assessing of moisture behaviour, energy comsumption, acoustic protection and fire control |
| | Assessing the building stability |
| | Basics of building services Tech work the new the of eliferational effects are an encoded in and within form |
| | Each week the results of different work steps are presented in oral and written form |
| Literature | Vortragsfolien der Lehrveranstaltung stehen über STUD.IP zum download zur Verfügung |
| | |
| | |
| | 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, Däche |
| | 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 f |
| | 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 |
| | Gebäude, Räume, Einrichtungen, Geräte mit dem Menschen als Maß und Ziel ; Handbuch für den Baufachmann, Bauher |
| | |
| | Lehrenden und Lernenden |
| | ISBN: 978-3-8348-0732-8 (GB.) |
| | Wiesbaden : Vieweg + Teubner, 2009 |

| Courses | | | | | |
|-------------------------------------|----------------------------------|--------------------------|--|---|---------------------|
| Title | | | Тур | Hrs/wk | СР |
| Project Concrete Structures II (L08 | 94) | | Project Seminar | 1 | 1 |
| Concrete Structures II (L0348) | | | Lecture | 2 | 3 |
| Concrete Structures II (L0349) | | | Recitation Section (large) | 2 | 2 |
| Module Responsible | Prof. Günter Romba | ch | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | • Knowlodgo o | floads on structures an | d combination of actions | | |
| Knowledge | - | | d combination of actions | | |
| | | ety format are required. | | | |
| | - | - | olumns for ultimate limit state | | |
| | Modules: Rel | niorcea concrete struct | ures I, Structural Analysis I+II, Mechanics I+II | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | After taking part su | ccessfully, students hav | e reached the following learning results | | |
| Professional Competence | | | | | |
| Knowledge | | | nich are required for design of reinforced cor | ncrete structures. Th | ney know the variou |
| | methods to estimat | e the member forces in | simple one and two-way slabs. | | |
| Skills | The students | s can design reinforced | concrete structure in the ultimate limit st | ate (shear, bending | torsion) and in th |
| | | - | leflection control) including detailing (anchora | - | ,, |
| | - | | per forces of simple slabs. | g = = · · · = · · · · · = · = · · · / · | |
| | | | he layout of a structural analysis | | |
| | | | | | |
| Personal Competence | | | | | |
| Social Competence | Cooperation in a pr | oject work, where they o | lesign in a team a real concrete building and p | present the results at | the end. |
| Autonomy | | | | | |
| Workload in Hours | Independent Study | Time 110, Study Time ii | n Lecture 70 | | |
| Credit points | 6 | | | | |
| Course achievement | Compulsory Bonus | Form | Description | | |
| | Yes None | Excercises | | | |
| | Written exam | | | | |
| Examination duration and | 120 minutes | | | | |
| scale | | | | | |
| Assignment for the | General Engineerin | g Science (German prog | ram, 7 semester): Specialisation Civil Enginee | ring: Elective Compu | llsory |
| Following Curricula | General Engineerin | g Science (German prog | ram, 7 semester): Specialisation Civil Enginee | ring: Elective Compu | llsory |
| | Civil- and Environm | ental Engineering: Core | Qualification: Compulsory | | |
| | Civil- and Environm | ental Engineering: Spec | ialisation Civil Engineering: Compulsory | | |
| | Civil- and Environm | ental Engineering: Spec | ialisation Traffic and Mobility: Elective Compul | sory | |
| | Civil- and Environm | ental Engineering: Spec | ialisation Water and Environment: Elective Co | mpulsory | |
| | General Engineering | a Science (English progr | am, 7 semester): Specialisation Civil Engineer | ina: Elective Compul | sorv |

| Course L0894: Project Concr | Course L0894: Project Concrete Structures II | |
|-----------------------------|---|--|
| Тур | Project Seminar | |
| Hrs/wk | 1 | |
| CP | 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 Stru | ourse L0348: Concrete Structures II | | |
|-----------------------------|---|--|--|
| 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 | WiSe | | |
| Content | Design of concrete members for shear, punching and torsion Design for serviceability limit state (durability): crack- and deflection control Detailing Design of discontinuity regions (e.g. corbels, frame corner) design of footings Introduction in the design of slabs Layout and content of a structural design | | |
| Literature | Vorlesungsumdrucke zum downloaden im STUDiP Zilch K., Zehetmaier G.: Bemessung im konstruktiven Betonbau. Springer Verlag, 2010 König G., Tue N.: Grundlagen des Stahlbetonbaus. Teubner Verlag, Stuttgart 1998 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. | | |

| ourse 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 M0730: Comp | , , | | | | |
|--|---|--|---|---|--|
| 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 | | Recitation Section (Smail) | 1 | 2 |
| Admission Requirements | None | | | | |
| | Basic knowledge in electrical er | ngineering | | | |
| Knowledge | | 5 5 | | | |
| Educational Objectives | After taking part successfully, s | tudents have reached the foll | owing learning results | | |
| Professional Competence | | | | | |
| Knowledge | This module deals with the fou programming down to gates. The Introduction | | | ers the layers fron | n the assembly-le |
| | Combinational logic: Gat Sequential logic: Flip-flog Technological foundation Computer arithmetic: Int | os, automata, systematic hard Is eger addition, subtraction, mu | - | | works |
| | - | rchies, SRAM, DRAM, caches e perspective of the CPU, prim | ciples of passing data, point-to- | point connections, | busses |
| Skills | The students perceive compute composition of computer system collection of few and simple co today's computing systems - fru After successful completion of system and the software exect on the hardware-centric abstra the impact that these low abstr | ms. The students can analyze, imponents. They are able to come gates and circuits up to co the module, the students are ted on it. In particular, they s ction layers from the assembl | how highly specific and individ distinguish between and to exp mplete processors. a able to judge the interdepen hall understand the consequent y language down to gates. This | dual computers can blain the different indencies between inces that the exect s way, they will be | n be built based of abstraction layer a physical compu- ution of software enabled to evalu |
| | the impact that these low abstr | | e system s performance and to | propose reasible c | iptions. |
| Personal Competence | | | | | |
| Social Competence | Students are able to solve simil | ar problems alone or in a grou | p and to present the results ac | cordingly. | |
| Autonomy | Students are able to acquire ne | w knowledge from specific lite | rature and to associate this kn | owledge with othe | r classes. |
| Workload in Hours | Independent Study Time 124, S | tudy Time in Lecture 56 | | | |
| Credit points | 6 | | | | |
| Course achievement | Compulsory Bonus Form Yes 10 % Excercis | Description | | | |
| Examination | Written exam | | | | |
| Examination duration and | 90 minutes, contents of course | and labs | | | |
| scale | | | | | |
| Assignment for the | General Engineering Science (G | erman program, 7 semester): | Specialisation Computer Scien | ce: Compulsory | |
| Following Curricula | General Engineering Science (G | erman program, 7 semester): | Specialisation Civil Engineering | g: Compulsory | |
| | General Engineering Science (G | erman program, 7 semester): | Specialisation Process Enginee | ering: Compulsory | |
| | General Engineering Science | (German program, 7 seme | ster): Specialisation Mechanic | cal Engineering, I | ocus Mechatron |
| | | (C | | | |
| | Compulsory | (German program, / semest | | - · · - | |
| | General Engineering Science | | er): Specialisation Mechanical | Engineering, Foc | us Aircraft Syste |
| | General Engineering Science Engineering: Compulsory | | | | |
| | General Engineering Science | | | | |
| | General Engineering Science Engineering: Compulsory General Engineering Science (C | ierman program, 7 semester) | Specialisation Mechanical Eng | ineering, Focus Th | eoretical Mechan |
| | General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls | erman program, 7 semester) (German program, 7 seme ory | Specialisation Mechanical Eng | ineering, Focus Th | eoretical Mechan Focus Materials |
| | General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C | erman program, 7 semester) (German program, 7 seme ory | Specialisation Mechanical Eng | ineering, Focus Th | eoretical Mechan Focus Materials |
| | General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls | ierman program, 7 semester) (German program, 7 seme ory German program, 7 semester, | Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En | ineering, Focus Th ical Engineering, gineering, Focus P | eoretical Mechan Focus Materials roduct Developm |
| | General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory | ierman program, 7 semester) (German program, 7 seme ory German program, 7 semester, (German program, 7 semest | Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical | ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc | eoretical Mechan Focus Materials roduct Developm us Energy System |
| | General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory | German program, 7 semester) (German program, 7 seme ory German program, 7 semester (German program, 7 semest (German program, 7 semest | Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical ster): Specialisation Mechanica | ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, F | eoretical Mechan Focus Materials roduct Developm us Energy System |
| | General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science (C | German program, 7 semester) (German program, 7 seme ory German program, 7 semester; (German program, 7 semest (German program, 7 semester): | Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical ster): Specialisation Mechanica Specialisation Naval Architectu | ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, F ure: Compulsory | eoretical Mechan Focus Materials roduct Developm us Energy Syste ocus Biomechan |
| | General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory | German program, 7 semester) (German program, 7 seme ory German program, 7 semester; (German program, 7 semest (German program, 7 semester): German program, 7 semester): | Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical ster): Specialisation Mechanic Specialisation Naval Architectu Specialisation Biomedical Engi | ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, F ure: Compulsory ineering: Compulso | eoretical Mechan Focus Materials roduct Developm us Energy Syste ocus Biomechan |
| | General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory General Engineering Science Compulsory General Engineering Science (C General Engineering Science (C | German program, 7 semester) (German program, 7 seme ory German program, 7 semester) (German program, 7 semest (German program, 7 semester): German program, 7 semester): German program, 7 semester): German program, 7 semester): | Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical ster): Specialisation Mechanical Specialisation Naval Architectu Specialisation Biomedical Engli Specialisation Bioprocess Engli Specialisation Electrical Engling | ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory neering: Compulsory | eoretical Mechan Focus Materials roduct Developm us Energy System ocus Biomechan pry ry |
| | General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory General Engineering Science Compulsory General Engineering Science (C General Engineering Science (C) | German program, 7 semester) (German program, 7 seme ory German program, 7 semester) (German program, 7 semest (German program, 7 semester): German program, 7 semester): German program, 7 semester): German program, 7 semester): | Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical ster): Specialisation Mechanical Specialisation Naval Architectu Specialisation Biomedical Engli Specialisation Bioprocess Engli Specialisation Electrical Engling | ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory neering: Compulsory | eoretical Mechan Focus Materials roduct Developm us Energy System ocus Biomechan pry ry |
| | General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory General Engineering Science Compulsory General Engineering Science (C General Engineering Science (C | German program, 7 semester) (German program, 7 seme ory German program, 7 semester) (German program, 7 semest (German program, 7 semester): German program, 7 semester): | Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical ster): Specialisation Mechanical Specialisation Naval Architectu Specialisation Biomedical Engli Specialisation Bioprocess Engli Specialisation Electrical Engling | ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory neering: Compulsory | eoretical Mechan Focus Materials roduct Developm us Energy System ocus Biomechan pry ry |
| | General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory General Engineering Science Compulsory General Engineering Science (C General Engineering Science (C | German program, 7 semester) (German program, 7 seme ory German program, 7 semester, (German program, 7 semest (German program, 7 semester): German program, 7 semester): | Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical ster): Specialisation Mechanical Specialisation Naval Architectu Specialisation Biomedical Engli Specialisation Bioprocess Engli Specialisation Electrical Engling | ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory neering: Compulsory | eoretical Mechan Focus Materials roduct Developm us Energy System ocus Biomechan pry ry |
| | General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory General Engineering Science Compulsory General Engineering Science (C General Engineering Science (C Compulsory Computer Science: Core Qualification Electrical Engineering: Core Qu | German program, 7 semester) (German program, 7 seme ory German program, 7 semester) (German program, 7 semest (German program, 7 semester) German program, 7 semester) Ger | Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical ster): Specialisation Mechanical Specialisation Naval Architectu Specialisation Biomedical Engi Specialisation Bioprocess Engi Specialisation Electrical Enging Specialisation Green Technolo | ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc cal Engineering, Focus neering: Compulsory gies, Focus Renew | eoretical Mechan Focus Materials roduct Developm us Energy System ocus Biomechan pry ry |
| | General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory General Engineering Science Compulsory General Engineering Science (C General Engineering Science (E General Engineering Science (E) | German program, 7 semester) (German program, 7 seme ory German program, 7 semester) (German program, 7 semest (German program, 7 semester) (German program, 7 semester) | Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical ster): Specialisation Mechanical Specialisation Naval Architectu Specialisation Biomedical Engin Specialisation Bioprocess Engi Specialisation Electrical Engine Specialisation Green Technolo | ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory gies, Focus Renew | eoretical Mechan Focus Materials roduct Developm us Energy Syste rocus Biomechan ory yry / able Energy: Elec |
| | General Engineering Science Engineering: Compulsory General Engineering Science (C Engineering: Compulsory General Engineering Science Engineering Sciences: Compuls General Engineering Science (C and Production: Compulsory General Engineering Science Compulsory General Engineering Science (C General Engineering Science (C Compulsory Computer Science: Core Qualification Electrical Engineering: Core Qu General Engineering Science (E | German program, 7 semester) (German program, 7 seme ory German program, 7 semester) (German program, 7 semester) (Cation: Compulsory (Cation: Compulsory (Cation: Compulsory (Cation: Compulsory (Cation) (Compulsory (Cation) (Cation) (Cat | Specialisation Mechanical Eng ester): Specialisation Mechan : Specialisation Mechanical En er): Specialisation Mechanical ster): Specialisation Mechanical Specialisation Naval Architectu Specialisation Biomedical Engin Specialisation Bioprocess Engi Specialisation Electrical Engine Specialisation Green Technolo | ineering, Focus Th ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory gies, Focus Renew :: Compulsory al Engineering, F | eoretical Mechan Focus Materials roduct Developm us Energy Syster rocus Biomechan ory ry dable Energy: Elec ocus Biomechan |

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

| Course L0321: Computer Eng | jineering |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Heiko Falk |
| Language | DE/EN |
| 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 Eng | ourse L0324: Computer Engineering | | |
|----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 1 | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Prof. Heiko Falk | | |
| Language | DE/EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Module M0628: Wate | r Management | | | |
|--------------------------------|---|--|--------------------|-----------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Groundwater Hydrology (L0251) | | Lecture | 2 | 2 |
| Groundwater Hydrology (L0252) | | Recitation Section (large) | 2 | 2 |
| Water Management and Water Qua | lity (L0366) | Lecture | 2 | 2 |
| Module Responsible | Prof. Mathias Ernst | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mathemaics I to III; Water Engineering I, 0 | Chemistry | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students h | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to define terms of the | hydrologic cycle and also parameters to identify | the water quality. | Typical aquifer type |
| | and the occuring 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 | | | |
| | | | | nysical background |
| | well hydraulics. Fundamentals of solute t | ransport can be reflected. | | |
| Skills | Students are able to use fundamental relationships of hydrology and water management for the solution of practical issues. | | | practical issues. The |
| | are in a position to rate water quality d | ata and to set up hydrological water balances. Th | ney are able to co | nstruct ground wat |
| | contour lines and streamlines on the ba | sis of head data. They have the ability to analyse | data of hydraulic | field and lab tests |
| | determine hydraulic conductivities and storage coefficients. | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to help each other solv | ving case studies. | | |
| Autonomy | Are not imparted in this module. | | | |
| Workload in Hours | Independent Study Time 96, Study Time | in Lecture 84 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 min | | | |
| scale | 1 | | | |
| Assignment for the | General Engineering Science (German pr | ogram, 7 semester): Specialisation Civil Engineerin | ig: Elective Compu | lsory |
| Following Curricula | Civil- and Environmental Engineering: Co | re Qualification: Compulsory | | |
| | Conoral Engineering Science (English pro | ogram, 7 semester): Specialisation Civil Engineering | . Flactive Commul | |

| Course L0251: Groundwater | Hydrology |
|---------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Nima Shokri |
| Language | EN |
| Cycle | WiSe |
| Content | 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 |
| | |

| Course L0252: Groundwater | Course L0252: Groundwater Hydrology | | |
|---------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Hannes Nevermann | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Course L0366: Water Manag | ement and Water Quality |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, 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 | | Тур | Hrs/wk | СР | |
| Nastewater Disposal (L0276) | | Lecture | 2 | 2 | |
| Wastewater Disposal (L0278) | | Recitation Section (large) | 1 | 1 | |
| Drinking Water Supply (L0306) | | Lecture | 2 | 1 | |
| Drinking Water Supply (L0308) | | Recitation Section (large) | 1 | 2 | |
| Module Responsible | Prof. Ralf Otterpohl | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Basic knowledge on Chemistry and Biol | ogy | | | |
| Knowledge | | | | | |
| | Hydraulics of pipe systems and open ch | | | | |
| | Basic knowledge on water managemen | | | | |
| | Basic knowledge on Environmental Leg | Islation: Federal Water Act | | | |
| Educational Objectives | After taking part successfully, students have r | eached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | The students can examplify their expert know | vledge on urban water infrastructures. They o | an present the de | erivation and detail | |
| | explanation of important standards for the de | sign of drinking water supply and wastewater | disposal systems | in Germany and th | |
| | are capable of reproducing the relevant empi | ricals assumptions and scientific simplifcation | s. The students ar | e able to present a | |
| | discuss sanitary engineering processes and t | he technologies used for drinking and waste | water treatment. | They can also asse | |
| | existing problems in the field of sanitary engine | | | - | |
| | draft the features and effectiveness of impor | | | | |
| | systems and techniques for the removal of tra | | and for pressure | | |
| | systems and teeningues for the removal of the | | | | |
| | | | | | |
| Skille | The students are able to apply the relevant s | tandards and guidelines for the design and o | neration of urban | water infrastructur | |
| 34///3 | s The students are able to apply the relevant standards and guidelines for the design and operation of urban water infrastructure 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 biochemica | | | | |
| | | | | | |
| | problems in the filed of drinking water and | | able to develop | ideas of their own | |
| | improve the existing water related infrastruct | ures, systems and concepts. | | | |
| | | | | | |
| Personal Competence | | | | | |
| | Social skills are not targeted in this module. | | | | |
| Social competence | Social skins are not targeted in this module. | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| Autonomy | Students are able to form concepts on their | own to optimize urban water infrastructure | processes. Theref | ore they can acqu | |
| | appropriate knowledge when being given so | me clues or information with regard to the a | pproach to proble | ems (preparation a | |
| | follow-up of the exercises). | 5 | | | |
| 147 | Independent Charles Times O.C. Ch. J. The Lat. | atura 94 | | | |
| Workload in Hours Credit points | Independent Study Time 96, Study Time in Le 6 | clure 84 | | | |
| | None | | | | |
| | Written exam | | | | |
| Examination duration and | | | | | |
| | | | | | |
| scale | Conoral Engineering Science (Corman progra | n, 7 semester): Specialisation Civil Engineerin | g: Elective Compu | lsory | |
| scale Assignment for the | General Engineering Science (Gennan bround | | | | |
| Assignment for the | General Engineering Science (German progra | m, 7 semester): Specialisation Green Technolo | gies: Compulsorv | | |
| Assignment for the | General Engineering Science (German program | • | gies: Compulsory | 2 | |
| Assignment for the | General Engineering Science (German program Civil- and Environmental Engineering: Core Qu | alification: Compulsory | gies: Compulsory | | |
| Assignment for the | General Engineering Science (German program | ualification: Compulsory ualification: Compulsory | | | |

| Тур | Lecture |
|-------------------|---|
| Hrs/wk | 2 |
| CP | 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, Membra 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 Auf München: Oldenbourg Industrieverl. |
| | Abwasser : Technik und Kontrolle. Neitzel, Volkmar, and Weinheim [u.a.]: Wiley-VCH, 1998. |
| | Kommunale Kläranlagen : Bemessung, Erweiterung, Optimierung, Betrieb und Kosten, (2009). Günthert, F. Wolfgang: völlig neu bearb. Aufl.). Renningen: expert-Verl. |
| | Water and wastewater technology Hammer, M. J. 1., & . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Educal 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 | |
| CP | 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 Wate | er Supply |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 | |

| | ulic Engineering | | | | | |
|-------------------------------|---|-----------------|----------------------|------------------------------------|-----------------|---------------------|
| Courses | | | | | | |
| Fitle | | | | Тур | Hrs/wk | СР |
| Hydraulics (L0957) | | | | Lecture | 1 | 1 |
| Hydraulics (L0958) | | | | Project-/problem-based Learning | 1 | 1 |
| Hydraulic Engineering (L0959) | | | | Lecture | 2 | 2 |
| Hydraulic Engineering (L0960) | | | | Project-/problem-based Learning | 1 | 2 |
| Module Responsible | Prof. Peter Fröhle | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Hydraulic Engineering I | | | | | |
| Knowledge | | | | | | |
| Educational Objectives | After taking part successfully, s | tudents have r | eached the followin | g learning results | | |
| Professional Competence | | | | | | |
| Knowledge | Students are able to define the | basic terms | of hydraulic engine | ering and hydraulics. They are | able to expla | in the application |
| 2 | | | | I hydraulic engineering probler | | |
| | | | | verview over river engineering | | |
| | engineering and waterways eng | | | | , | |
| | | | | | | |
| Skills | The students are able to apply | hydraulic engi | neering methods a | nd approaches to basic practic | al problems a | nd design respect |
| | hydraulic engineering systems | Besides this, | they are able to us | e and apply established approa | aches of hydra | aulics and determ |
| | water surfaces of channel flows | , influences of | constructions (weir | s, etc.) on channel flows as well | as flow condi | tions of pipe syste |
| | Furthermore, they are able to r | ın, explain and | document basic hy | /draulic experiments. | | |
| | | | | | | |
| Personal Competence | | | | | | |
| Social Competence | The students are able to deploy their gained knowledge in applied problems. Additionaly, they will be able to work in team wi | | | | | |
| | engineers of other disciplines | in a goal-oriei | ntated, structured | manner. They can explain thei | r results by u | use of peer learn |
| | approaches. | | | | | |
| Autonomy | The students will be able to ind | ependently ex | tend their knowledg | e and apply it to new problems | . Furthermore | , they are capable |
| | organising their individual work | flow to contrib | oute to the conduct | of experiments and to present | discipline-spec | cific knowledge. |
| Workload in Hours | Independent Study Time 110, S | tudy Time in L | ecture 70 | | | |
| Credit points | 6 | | | | | |
| Course achievement | Compulsory Bonus Form | | Description | | | |
| | Yes None Subject | | andDurchführung | | sentation zu | einem Versu |
| | practica | work | Hydromechan | ik oder Hydraulik | | |
| Examination | Written exam | | | | | |
| | | | The examination i | ncludes tasks with respect to | the general u | inderstanding of |
| scale | lecture contents and calculation | | | | | |
| Assignment for the | | | | cialisation Civil Engineering: Ele | - | - |
| Following Curricula | | | m, 7 semester): Sp | ecialisation Green Technologies | s, Focus Water | r and Environmen |
| | Engineering: Elective Compulsory | | | | | |
| | Civil- and Environmental Engine | ering: Core Qu | alification: Compute | sory | | |
| | General Engineering Science (E | nglish program | n, 7 semester): Spec | cialisation Civil Engineering: Ele | ctive Compuls | ory |
| | Green Technologies: Energy, W | ater, Climate: | Specialisation Wate | r: Elective Compulsory | | |
| | | | | | | |
| Course L0957: Hydraulics | | | | | | |
| Тур | Lecture | | | | | |
| Hrs/wk | 1 | | | | | |
| СР | 1 | | | | | |
| Workload in Hours | Independent Study Time 16, St | udy Time in Le | cture 14 | | | |
| Lecturer | Prof. Peter Fröhle | | | | | |
| Language | DE | | | | | |
| Cycle | WiSe/SoSe | | | | | |
| cycle | | | | | | |
| Content | Flow of incompressible fluids in | pipes and ope | n channels | | | |
| | Flow of incompressible fluids in • Hydraulics of pipes | pipes and ope | n channels | | | |

- Hydraulics of pipesPunps 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 | Project-/problem-based Learning |
| 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/SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L0959: Hydraulic Eng | ineering |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Peter Fröhle |
| Language | DE |
| Cycle | WiSe/SoSe |
| Content | Fundamentals of hydraulic engineering |
| | Introduction and hydrological cycle River engineering Regime theory of natural rivers Sediment transport Regulation of rivers Bank protection / protection of river bed Tidal rivers Flood protection Dikes Flood contraol basins Hydraulic power 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 |

| ourse L0960: Hydraulic Engineering | | | |
|------------------------------------|---|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 1 | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Prof. Peter Fröhle | | |
| Language | DE | | |
| Cycle | WiSe/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.

| Module M0886: Funda | amentals of Process Engir | neering and Material Engineerin | g | |
|---|---|---|------------------------------|---------------------|
| Courses | | | | |
| Title Introduction into Process Engineeri Fundamentals of material engineer | | Typ Lecture Lecture | Hrs/wk 2 2 | CP 1 2 |
| Module Responsible | - Prof. Michael Schlüter | | | |
| Admission Requirements | None | | | |
| Recommended Previous | none | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, studen | ts have reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After passing this module the student | ts have the ability to: | | |
| | | mportant fields on process and bioprocess engi s for different fields in process engineering. | neering, | |
| Skills | name the most important work read and prepare an engineeri explain the most important teo | tant fields of process engineering, king approaches or methods of the different fiel | ment | |
| Personal Competence Social Competence | The students are able to work out results in groups and provide appropriate feedback a | document them, and handle feedback on their own performance | constructively. | |
| Autonomy | The students are able to estimate th Engineering and Bioprocess Engineer | neir progress of learning by themselves and to ing. | o deliberate their lack of k | nowledge in Proces |
| Workload in Hours | Independent Study Time 34, Study Ti | me in Lecture 56 | | |
| Credit points | 3 | | | |
| Course achievement | | Description | | |
| P | No 5 % Written elabor | ation | | |
| Examination | | | | |
| Examination duration and scale | 90 min | | | |
| Assignment for the | Conoral Engineering Science (Corma | n program, 7 semester): Specialisation Process | Engineering: Compulsory | |
| Following Curricula | | n program, 7 semester): Specialisation Process n program, 7 semester): Specialisation Bioproce | | rv |
| g en reula | Bioprocess Engineering: Core Qualific | | | , |
| | 1 5 5 1 | program, 7 semester): Specialisation Bioproce | ss Engineering: Compulsor | У |
| | | program, 7 semester): Specialisation Process I | | |
| | Orientierungsstudium: Core Qualificat | tion: Elective Compulsory | | |
| | Process Engineering: Core Qualification | on: Compulsory | | |

| Course L0829: Introduction into Process Engineering/Bioprocess Engineering | |
|--|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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: Fundamentals | s of material engineering | |
|----------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | | |
| CP | | |
| 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. | |

| ourses | | | | |
|-----------------------------|--|--|--|--|
| ourses | | | | |
| itle | | Тур | Hrs/wk | СР |
| omputer Engineering (L0321) | | Lecture Recitation Section (small) | 3 1 | 4 2 |
| omputer Engineering (L0324) | Dref Lielle Felle | Recitation Section (smail) | 1 | Z |
| Module Responsible | None | | | |
| Admission Requirements | Basic knowledge in electrical engineering | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the | e following learning results | | |
| Professional Competence | | 5 5 | | |
| | This module deals with the foundations of the function programming down to gates. The module includes the fo Introduction Combinational logic: Gates, Boolean algebra, Bool Sequential logic: Flip-flops, automata, systematic Technological foundations Computer arithmetic: Integer addition, subtraction Basics of computer architecture: Programming mo Memories: Memory hierarchies, SRAM, DRAM, cac Input/output: I/O from the perspective of the CPU, The students perceive computer systems from the architecture and a subtraction of computer systems. The students can ana | ellowing topics: lean functions, hardware synthesis, c hardware design n, multiplication and division odels, MIPS single-cycle architecture, hes principles of passing data, point-to-p tect's perspective, i.e., they identify ilyze, how highly specific and individ | ombinational net pipelining point connections, the internal struct ual computers car | works , busses ture and the phys n be built based o |
| | collection of few and simple components. They are able today's computing systems - from gates and circuits up the After successful completion of the module, the student system and the software executed on it. In particular, the on the hardware-centric abstraction layers from the asso the impact that these low abstraction levels have on an | to complete processors. Its are able to judge the interdepend ney shall understand the consequence embly language down to gates. This | dencies between tes that the exect way, they will be | a physical comp ution of software e enabled to evalu |
| Personal Competence | | | | |
| Social Competence | Students are able to solve similar problems alone or in a | group and to present the results acc | ordingly. | |
| 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 | | | | |
| Course achievement | | | | |
| | Yes 10 % Excercises | | | |
| | | | | |
| | 90 minutes, contents of course and labs | | | |
| scale Assignment for the | General Engineering Science (German program, 7 semes | tor), Specialization Computer Science | o Compulsory | |
| Following Curricula | General Engineering Science (German program, 7 semes General Engineering Science (German program, 7 semes Compulsory General Engineering Science (German program, 7 semes Compulsory General Engineering Science (German program, 7 semes Engineering: Compulsory General Engineering Science (German program, 7 semes Engineering Science (German program, 7 semes Engineering: Compulsory General Engineering Science (German program, 7 semes Engineering: Compulsory General Engineering Science (German program, 7 semes Engineering: Compulsory General Engineering Science (German program, 7 semes and Production: Compulsory General Engineering Science (German program, 7 semes and Production: Compulsory General Engineering Science (German program, 7 semes and Production: Compulsory | ster): Specialisation Naval Architectu ster): Specialisation Electrical Engine ster): Specialisation Biomedical Engin ster): Specialisation Energy and Envir ster): Specialisation Process Engineer semester): Specialisation Mechanica emester): Specialisation Mechanical mester): Specialisation Mechanical semester): Specialisation Mechanical ster): Specialisation Mechanical Engi | re: Compulsory ering: Compulsory eering: Compulsory eering: Compulsory al Engineering, I al Engineering, Foc cal Engineering, Foc cal Engineering, Focus Fh ineering, Focus Fh Engineering, Focus F | y y y ring: Compulsory Focus Mechatror focus Biomechar cus Aircraft Syste Focus Materials heoretical Mechar Product Developm us Energy Syste |
| | Compulsory General Engineering Science (German program, 7 ser | mester): Specialisation Mechanical | Engineering, roc | us Energy Syste |

| 1 1 | Consel Engineering Colored (English angular). Conselection Engineering and Engineering Computers |
|-----|--|
| | General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Computer Science: 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 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 Naval Architecture: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory |
| | Computational Science and Engineering: Core Qualification: Compulsory |
| | Mechatronics: Core Qualification: Compulsory |
| | Technomathematics: Specialisation II. Informatics: Elective Compulsory |

| Course L0321: Computer Engineering | | |
|------------------------------------|---|--|
| Тур | cture | |
| Hrs/wk | 3 | |
| CP | 4 | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE/EN | |
| 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 |
| CP | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Heiko Falk |
| Language | DE/EN |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Courses | | | | |
|--|---|---|--|----------------|
| Title Fundamentals of Fluid Mechanics (I | .0091) | Typ Lecture | Hrs/wk 2 | CP 4 |
| Fluid Mechanics for Process Engine | ering (L0092) | Recitation Section (large) | 2 | 2 |
| Module Responsible | Prof. Michael Schlüter | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Mathematics I+II+III Technical Mechanics I+II Technical Thermodynamics I+II Working with force balances Simplification and solving of partial different Integration | tial equations | | |
| Educational Objectives | After taking part successfully, students have reach | ed the following learning results | | |
| Professional Competence Knowledge | | | | |
| Skills | The students are able to 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 | | | | |
| | The students are capable to gather information from subject related, professional publications and relate that information to the conterest of the lecture and able to work together on subject related tasks in small groups. They are able to present their results effectively in Englis (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. 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 in Lectur | re 56 | | |
| Credit points | 6 | | | |
| Course achievement | Compulsory Bonus Form Yes 5 % Midterm | Description | | |
| Examination | | | | |
| Examination Examination duration and scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 | semester): Specialisation Process Engineer | ing: Compulsory | |
| - | General Engineering Science (German program, 7 General Engineering Science (German program, 7 General Engineering Science (German program, 7 Bioprocess Engineering: Core Qualification: Compu Energy and Environmental Engineering: Core Qual General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, 7 Science (English program, 7 Science) (English program) (English | semester): Specialisation Bioprocess Engin semester): Specialisation Energy and Envir semester): Specialisation Green Technolog Ilsory ification: Compulsory semester): Specialisation Bioprocess Engine semester): Specialisation Energy and Enviro semester): Specialisation Process Engineeri | eering: Compulso omental Enginee ies: Compulsory eering: Compulso omental Engineer | y |

| Course L0091: Fundamentals | of Fluid Mechanics |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. Michael Schlüter |
| Language | DE |
| Cycle | SoSe |
| 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. München, Pearson Studium, 2007 Oertl, H.: 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 |

| Course L0092: Fluid Mechani | cs 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. |
| | 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. 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 | | 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 | none | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the follo | wing learning results | | |
| Professional Competence | | | | |
| Knowledge | At the end of this module the students can: | | | |
| | - explain the methods of biological and biochemical research t | o determine the properties of biom | olecules | |
| | - name the basic components of a living organism | | | |
| | - 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 students | | | |
| | - to introduce their own knowledge and to argue their view in | discussions in teams | | |
| | - to divide a complex task into subtasks, solve these and to pr | esent the combined results | | |
| Autonomy | The students are able to present the results of their subtasks i | n a written report | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 | | | |
| | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| | 90 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 semester): | Specialisation Bioprocess Engineer | ing: Compulso | ry |
| - | Bioprocess Engineering: Core Qualification: Compulsory | | | - |
| J | General Engineering Science (English program, 7 semester): S | pecialisation Bioprocess Engineeri | ng: Compulsor | v |
| | Orientierungsstudium: Core Qualification: Elective Compulsory | | 5 | - |
| | | | | |

| Course L0351: Biochemistry | |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 2 |
| 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 Anaerobic 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: Biochemistry | |
|----------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 1 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Paul Bubenheim |
| Language | DE |
| Cycle | SoSe |
| Content | |
| | 1. The molecular logic of Life |
| | 2. Biomolecules: |
| | 1. Amino acids, peptides, proteins |
| | 2. Carbohydrates |
| | 3. Lipids |
| | 3. Protein functions, Enzymes: |
| | 1. Michaelis-Menten kinetics |
| | 2. Enzyme regulation |
| | 3. Enzyme nomenclature |
| | 4. Cofactors and cosubstrates, vitamines |
| | 5. Metabolism: |
| | 1. Basic principles |
| | 2. Photosynthesis |
| | 3. Glycolysis |
| | 4. Citric acid cycle |
| | 5. Respiration |
| | 6. Anaerobic respirations |
| | 7. Fatty acid metabolism |
| | 8. 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: Microbiology | |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Neele Meyer-Heydecke |
| Language | DE |
| Cycle | SoSe |
| Content | The procaryotic cell evolution taxonomy and specific properties of Archaea, Bacteria, and viruses structure and properties of the cell growth Metabolism fermentation and anaerobic respiration methanogenesis and the anaerobic food chain degradation of polymers chemolithotrophy 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: Microbiology | |
|----------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 1 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Barbara Klippel |
| Language | DE |
| Cycle | SoSe |
| Content | The procaryotic cell evolution taxonomy and specific properties of Archaea, Bacteria, and viruses structure and properties of the cell growth Metabolism fermentation and anaerobic respiration methanogenesis and the anaerobic food chain degradation of polymers chemolithotrophy Microorganisms in relation to the environment chemotaxis and motility Elemental cycle of carbon, nitrogen and sulfur biofilms symbiotic relationships |
| Literature | extremophiles biotechnology 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/ |

| | .0140) .0142) | Typ Lecture Recitation Section (small) Recitation Section (large) | Hrs/wk 2 1 1 | CP 2 2 2 |
|---|--|--|--|---|
| hase Equilibria Thermodynamics () hase Equilibria Thermodynamics () hase Equilibria Thermodynamics () Module Responsible Admission Requirements Recommended Previous | .0140) .0142) Prof. Irina Smirnova None | Lecture Recitation Section (small) Recitation Section (large) | 2 | 2 2 |
| hase Equilibria Thermodynamics (I hase Equilibria Thermodynamics (I Module Responsible Admission Requirements Recommended Previous | .0140) .0142) Prof. Irina Smirnova None | Recitation Section (small) Recitation Section (large) | 1 | 2 |
| hase Equilibria Thermodynamics (I Module Responsible Admission Requirements Recommended Previous | .0142) Prof. Irina Smirnova None | Recitation Section (large) | | |
| Module Responsible Admission Requirements Recommended Previous | Prof. Irina Smirnova None | | 1 | |
| Admission Requirements Recommended Previous | None | odvnamics I and II | | 2 |
| Recommended Previous | | odvnamics I and II | | |
| | Mathematics, Physical Chemistry, Therm | odvnamics I and II | | |
| | | | | |
| Educational Objectives | After taking part successfully, students h | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge Skills | equilibria. They learn how state variables are these properties. Moreover, the students learn how different phases (vapor, liquid, sol For different phase equilibria, see knowledge for plotting and interprese knowledge for plotting and interprese state and know how to simplify the The students know models which are able to solve the resulting mat For specific applications, they are model parameters in literature sou Beside pure compound properties The students know how to visualiz | idents are able to identify the correct equation for ese equations meaningfully. can be used to determine the properties of the syst chematical relations. able to self-reliantly find necessary physico-chemica | n concepts to qu and which pher atals of reaction e cesses are shown the determination tem in the equili al properties of c s of mixtures. interpret the occ | uantitatively desc nomena may occu equilibria are taug n and the necess on of the equilibr brium state and t ompounds as wel urring phenomen |
| Personal Competence Social Competence Autonomy | other students The students are able to find nece | groups, to solve the corresponding problems and to ssary information self-reliantly in literature sources a ts are able to check their learning progress conti | and to judge their | quality. |
| | | | | |
| | Independent Study Time 124, Study Time | e in Lecture 56 | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | Written exam | | | |
| | 120 minutes; theoretical questions and c | alculations | | |
| scale | | | | |
| Assignment for the Following Curricula | 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, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory | | | |

| rse L0114: Phase Equilib | ria Thermodynamics | |
|--------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| CP | 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: 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. 3 rd ed. Prentice Hall, 1997.J.P. O'Connell, J.M. Haile Thermodynamics. Cambridge University Press, 2005. | |

| Course L0140: Phase Equilib | ria Thermodynamics | |
|-----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| CP | | |
| 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: 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 Equilib | ria Thermodynamics | |
|-----------------------------|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | | |
| Workload in Hours | ndependent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | of. 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: eaction 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 | | | | |
|--|---|--|--|--|
| | | Turn | Line /usis | CP |
| Title Bioprocess Engineering - Fundame | otals (10841) | Typ Lecture | Hrs/wk | СР 3 |
| Bioprocess Engineering- Fundamen | | Recitation Section (large) | 2 | 1 |
| Bioprocess Engineering - Fundame | | Practical Course | 2 | 2 |
| Module Responsible | Prof. Andreas Liese | | | |
| | | | | |
| Recommended Previous | | "fundamentals for process engineering" | | |
| Knowledge | none, module organic chemistry , module | randamentals for process engineering | | |
| | After taking part successfully, students have | e reached the following learning results | | |
| Professional Competence | Arter taking part successivity, stadents have | | | |
| | enzymes and microorganisms, as well as rheology can be named and mass transp fundamental bioprocess management, steri | cepts of bioprocess engineering. They are able to differentiate different types of inhibition. ort processes in bioreactors can be explained lization technology and downstream processing | The parameters of . The students are | f stoichiometry a |
| Skills | After successful completion of this module, describe different kinetic approaches | students should be able to for growth and substrate-uptake and to calcula | te the correspondir | ng parameters |
| Autonomy Workload in Hours | fermentation process analyze bioprocesses on basis of stoi distinguish between scale-up criteria to compare them as well as to apply propose solutions to complicated biol to explore new knowledge resources identify scientific problems with conc to document and discuss their proced After completion of this module participants take position to their own opinions and incre After completion of this module participants workflow and to present their results in a p Independent Study Time 96, Study Time in I | | quations erobic, aerobic as v sponding models in small teams to e and scientific envir | vell as microaerob nhance the ability onments. |
| Credit points | | | | |
| Course achievement Compulsory Bonus Form Description | | | | |
| | Yes 5 % Subject theoretica | | | |
| | | | | |
| Page and Inc. 14 | practical work | | | |
| | practical work Written exam | | | |
| Examination duration and scale | practical work Written exam 90 min | | | |
| Examination duration and scale | practical work Written exam 90 min General Engineering Science (German progr | ram, 7 semester): Specialisation Process Engine | | |
| Examination duration and scale | practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr | ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng | | ıry |
| Examination duration and scale | practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: | ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory | ineering: Compulso | |
| Examination duration and scale | practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progra | ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Engi | ineering: Compulso | |
| Examination duration and scale | practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progra General Engineering Science (English progra | ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Engi am, 7 semester): Specialisation Process Enginee | ineering: Compulso neering: Compulso ring: Compulsory | |
| Examination duration and scale | practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progr General Engineering Science (English progr Biomedical Engineering: Specialisation Artifi | ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Engi am, 7 semester): Specialisation Process Enginee icial Organs and Regenerative Medicine: Compu | ineering: Compulso neering: Compulso ring: Compulsory | |
| Examination duration and scale | practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progr General Engineering Science (English progr Biomedical Engineering: Specialisation Artifi Biomedical Engineering: Specialisation Impl | ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Engi am, 7 semester): Specialisation Process Enginee icial Organs and Regenerative Medicine: Compu ants and Endoprostheses: Elective Compulsory | ineering: Compulso neering: Compulso ring: Compulsory Isory | |
| Examination duration and scale | practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progr General Engineering Science (English progr Biomedical Engineering: Specialisation Artifi Biomedical Engineering: Specialisation Impl Biomedical Engineering: Specialisation Medi | ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Engi am, 7 semester): Specialisation Process Enginee icial Organs and Regenerative Medicine: Compu ants and Endoprostheses: Elective Compulsory ical Technology and Control Theory: Elective Co | ineering: Compulso neering: Compulso ring: Compulsory Isory mpulsory | |
| Examination duration and scale | practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progr General Engineering Science (English progr Biomedical Engineering: Specialisation Artifi Biomedical Engineering: Specialisation Impl Biomedical Engineering: Specialisation Medi | ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Engi am, 7 semester): Specialisation Process Enginee icial Organs and Regenerative Medicine: Compu ants and Endoprostheses: Elective Compulsory ical Technology and Control Theory: Elective Co agement and Business Administration: Elective Co | ineering: Compulso neering: Compulso ring: Compulsory Isory mpulsory | |

| Course L0841: Bioprocess En | gineering - Fundamentals | | |
|-----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| CP | } | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | rof. 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) 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 | 1. Introduction (Prof. Liese, Prof. Zeng) | |
| | 2. Enzymatic kinetics (Prof. Liese) | |
| | 3. Stoichiometry I + II (Prof. Liese) | |
| | 4. Microbial Kinetics I+II (Prof. Zeng) | |
| | 5. Rheology (Prof. Liese) | |
| | 6. Mass transfer in bioprocess (Prof. Zeng) | |
| | 7. Continuous culture (Chemostat) (Prof. Zeng) | |
| | 8. Sterilisation (Prof. Zeng) | |
| | 9. Downstream processing (Prof. Liese) | |
| | 10. Repetition (Reserve) (Prof. Liese, Prof. Zeng) | |
| Literature | siehe Vorlesung | |

| Course L0843: Bioprocess En | ngineering - 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 | | Тур | Hrs/wk | СР |
| Heat and Mass Transfer (L0101) Heat and Mass Transfer (L0102) | | Lecture Recitation Section (small) | 2 1 | 2 2 |
| Heat and Mass Transfer (L1868) | | Recitation Section (large) | 1 | 2 |
| Module Responsible | Prof. Irina Smirnova | | | |
| Admission Requirements | | | | |
| Recommended Previous | Basic knowledge: Technical Thermodynamics | | | |
| Knowledge | | | | |
| | | | | |
| Educational Objectives | After taking part successfully, students have reached the follo | wing learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are capable of explaining qualitative and | determining quantitative heat t | ransfer in proce | dural apparatus (e |
| | The students are capable of explaining qualitative and heat exchanger, chemical reactors). | determining quantitative near t | | |
| | They are capable of distinguish and characterize differ | ent kinds of heat transfer mech | anisms namely h | eat conduction, h |
| | transfer and thermal radiation. | | 5 | |
| | The students have the ability to explain the physica | al basis for mass transfer in o | letail and to de | scribe mass tran |
| | qualitative and quantitative by using suitable mass tran | nsfer theories. | | |
| | They are able to depict the analogy between heat- and | mass transfer and to describe of | complex linked p | rocesses in detail. |
| | | | | |
| | | | | |
| | | | | |
| Skills | | | | |
| | The students are able to set reasonable system bound | | blem by using th | ne gained knowled |
| | and to balance the corresponding energy and mass flow | | | |
| | They are capable to solve specific heat transfer proble | ems (e.g. heated chemical reac | tors, temperatur | e alteration in flu |
| | and to calculate the corresponding heat flows. | | | |
| | Using dimensionless quantities, the students can execu- | | | |
| | They are able to distinguish between diffusion, convec | | | n use this knowled |
| | for the description and design of apparatus (e.g. extrac | | | |
| | In this context, the students are capable to choose and application considering their advantages and disadvantages. | | eat and mass exe | changer for a spec |
| | application considering their advantages and disadvant | | ocodural apparat | |
| | In addition, they can calculate both, steady-state and n The students are capable to connect their knowled | | | |
| | particular the courses thermodynamics, fluid mechan | - | - | |
| | problems. | ines and chemical process eng | incernig, to solv | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| ···· ,·· · | The students are capable to work on subject-specific of | challenges in teams and to pres | ent the results o | orally in a reasona |
| | manner to tutors and other students. | | | |
| | | | | |
| | | | | |
| Autonomy | | | | |
| Autonomy | The students are able to find and evaluate necessary in | | | |
| | They are able to prove their level of knowledge during | ing the course with accompany | ying procedure | continuously (click |
| | system, exam-like assignments) and on this basis they | can control their learning proce | sses. | |
| | | | | |
| Marcalda and the | Independent Church Time 124, Church Time 1, 1, 1, 5, 5, 5, | | | |
| | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points Course achievement | | | | |
| | Written exam | | | |
| | 120 minutes; theoretical questions and calculations | | | |
| scale | | | | |
| | General Engineering Science (German program, 7 semester): | Specialisation Process Engineer | ina: Compulsory | |
| Following Curricula | | | | |
| 3 • • • • • • | General Engineering Science (German program, 7 semester): | | ÷ . | - |
| | General Engineering Science (German program, 7 semester): | | | ring: Compulsory |
| | Bioprocess Engineering: Core Qualification: Compulsory | | - | |
| | Energy and Environmental Engineering: Core Qualification: Co | ompulsory | | |
| | General Engineering Science (English program, 7 semester): S | Specialisation Bioprocess Engine | ering: Compulso | ry |
| | General Engineering Science (English program, 7 semester): S | Specialisation Energy and Enviro | mental Engineer | ing: Compulsory |
| | General Engineering Science (English program, 7 semester): S | Specialisation Process Engineeri | ng: Compulsory | |
| | Green Technologies: Energy, Water, Climate: Core Qualification | on: Compulsory | | |
| | Technomathematics: Specialisation III. Engineering Science: E | lective Compulsory | | |
| | Process Engineering: Core Qualification: Compulsory | | | |

| Course L0101: Heat and Mas | s Transfer |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Irina Smirnova |
| Language | DE |
| Cycle | WiSe |
| Content | 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 Mas | ourse L0102: Heat and Mass Transfer | |
|----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| CP | 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 Mas | ourse L1868: Heat and Mass Transfer | |
|----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | 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 | |

| 18) 19) | Typ Lecture | Hrs/wk | СР |
|--|--|--|--|
| | Lecture | | |
| 19) | | 2 | 2 |
| | Recitation Section (small) | 2 | 2 |
| 41) | Recitation Section (large) | 1 | 1 |
| Part laine Casimena | Practical Course | I | 1 |
| Prof. Irina Smirnova | | | |
| | | | |
| Recommended requirements: Thermodynamics III | | | |
| After taking part successfully, students have reached th | ne following learning results | | |
| | | | |
| adsorptionThe students develop an understanding for the energy demand of a process, the possibilities of a statement of the s | course of concentration during a sepa energy saving, and the selection of sep | aration process, t paration systems | he estimation of t |
| close the associated energy and material balance. The students can use different graphical meth theoretical stages required They can select and design a basic type of the disadvantages of the process The students are capable to obtain independent tables) They can calculate continuous and discontinuous The students are able to prove their theoretical k The students are able to discuss the theoretical colloquium. | es lods for the designing of a separation ermal separation process for a given tly the needed material properties from s processes knowledge in the experimental lab work background and the content of the ex | n process and do case based on m appropriate so k. kperimental work and use it togeth | efine the amount the advantages a urces (diagrams a with the teachers |
| The students can work technical assignments in small groups and present the combined results in the tutorial The students are able to carry out practical lab work in small groups and organize a functional division of labor between the students are able to carry out practical lab work in small groups and organize a functional division of labor between the students are able to carry out practical lab work in small groups and organize a functional division of labor between the students are able to carry out practical lab work in small groups and organize a functional division of labor between the students are able to carry out practical lab work in small groups and organize a functional division of labor between the students are able to carry out practical lab work in small groups and organize a functional division of labor between the students are able to carry out practical lab work in small groups and organize a functional division of labor between the students are able to carry out practical lab work in small groups and organize a functional division of labor between the students are able to carry out practical lab work in small groups and organize a functional division of labor between the students are able to carry out practical lab work in small groups and organize a functional division of labor between the students are able to carry out practical lab work in small groups and practical lab work in small groups and practical lab work in small groups are students are able to carry out practical lab work in small groups and practical lab work in small groups and practical lab work in small groups and practical lab work in small groups are students are students are students. | | | |
| them. They are able to discuss their results and to document them scientifically in a report. The students are capable to obtain the needed information from suitable sources by themselves and assess their quality The students can proof the state of their knowledge with exam resembling assignments and in this way control th learning process | | | |
| Independent Study Time 96, Study Time in Lecture 84 | | | |
| 6 | | | |
| None | | | |
| Written exam | | | |
| 120 minutes; theoretical questions and calculations | | | |
| General Engineering Science (German program, 7 seme | ester): Specialisation Process Engineer | ing: Compulsory | |
| General Engineering Science (German program, 7 seme Compulsory General Engineering Science (German program, 7 seme Compulsory General Engineering Science (German program, 7 seme Bioprocess Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualificat General Engineering Science (English program, 7 seme | ester): Specialisation Green Technologi semester): Specialisation Green Tech ester): Specialisation Energy and Enviro / ion: Elective Compulsory ster): Specialisation Bioprocess Engine ster): Specialisation Energy and Enviro | ies, Focus Renew Inologies, Focus omental Engineer eering: Compulsor omental Engineeri | able Energy: Elect Renewable Energ ring: Compulsory Y |
| | The students can distinguish and describe diffiadsorption The students develop an understanding for the energy demand of a process, the possibilities of They have good knowledge of designing method Using the gained knowledge the students can secose the associated energy and material balance. The students can use different graphical meth theoretical stages required They can select and design a basic type of the disadvantages of the process The students are capable to obtain independent tables) The students are capable to obtain independent tables) The students are able to discuss the theoretical key in the students are able to discuss the theoretical colloquium. The students are capable of linking their gained knowle technical problems. Other lectures such as thermodyna The students are able to carry out practical lab them. They are able to discuss their results and limes. The students are capable to obtain the needed in the students are capable to obtain the needed in the students are capable to obtain the needed in the students are capable to obtain the needed in the students can proof the state of their knowlearning process Independent Study Time 96, Study Time in Lecture 84 6 None Written exam 120 minutes; theoretical questions and calculations General Engineering Science (German program, 7 seme General Engineering Science (German program, 7 | Recommended requirements: Thermodynamics III After taking part successfully, students have reached the following learning results The students can distinguish and describe different types of separation processes adsorption The students develop an understanding for the course of concentration during a separenergy demand of a process, the possibilities of energy saving, and the selection of separation processes and devices They have good knowledge the students can select a reasonable system boundary for close the associated energy and material balances The students can use different graphical methods for the designing of a separation theoretical stages required They can select and design a basic type of thermal separation process for a given disadvantages of the process The students are capable to obtain independently the needed material properties fror tables) They can calculate continuous and discontinuous processes The students are able to prove their theoretical knowledge in the experimental lab wor tables of the students are capable of linking their gained knowledge with the content of other lectures colloquium. The students are able to factures such as thermodynamics, fluid mechanics and chemical er them. They are able to discuss their results and to document them scientifically in a regulater and process. The students are capable to obtain the needed information from suitable sources by th The students are capable to obtain the needed information from suitable sources by th The students are capable to obtain the needed information from suitable sources by th The students are capable to obtain the needed information from suitable sources by th The students are capable to obtain the needed information from suitable sources by th The students are capable to obtain the needed information from suitable sources by th The students are capable to obtain t | Recommended requirements: Thermodynamics III After taking part successfully, students have reached the following learning results The students can distinguish and describe different types of separation processes such as distillat adsorption The students develop an understanding for the course of concentration during a separation process, 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 Using the gained knowledge the students can select a reasonable system boundary for a given separat close the associated energy and material balances The students can use different graphical methods for the designing of a separation process and d theoretical stages required They can select and design a basic type of thermal separation process for a given case based on disadvantages of the process The students are capable to obtain independentity the needed material properties from appropriate so tables) The students are capable to obtain independentity the needed material properties from appropriate so tables) The students are able to prove their theoretical background and the content of the experimental work colloquium. The students are able to giscuss the theoretical background and the content of the reperimental work colloquium. The students can work technical assignments in small groups and present the combined results in the to the students can proof the state of their knowledge with texam resembling assignments and in th learning process The students can proof the state of their knowledge with exam resembling assignments and in th learning process The students are capable to obtain the needed information from suitable sources by themselves and as the students are able to acary out practical lab work in small groups and organize a functional divisi them. They are able to acary out practical lab work in small groups and organize a functional in th learning process The students can proof t |

Process Engineering: Core Qualification: Compulsory

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| Тур |
|-------------------|
| Hrs/wk |
| CP |
| Workload in Hours |
| Lecturer |
| Language |
| Cycle |
| Content |
| Literature |

| ourse L0119: Thermal Sepa | ration Processes | | |
|---------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| CP | | | |
| 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 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 separatio 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 Sepa | |
|--------------------------|---|
| 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 198 Ullmann"s Enzyklopädie der Technischen Chemie |

| L1159: Separation Pr | Practical Course |
|----------------------|--|
| Hrs/wk | 1 |
| CP | |
| | Independent Study Time 16, Study Time in Lecture 14 |
| | Prof. Irina Smirnova |
| | |
| Language | |
| Cycle Content | The students work on eight different experiments in this practical course. For every one of the eight experiments, a colloquiur takes place in which the students explain and discuss the theoretical background and its translation into practice with staff an fellow students. |
| | The students work small groups with a high degree of division of labor. For every experiment, the students write a report. The 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 separatic 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 198 Ullmann"s Enzyklopädie der Technischen Chemie |

| Module M0892: Chem | ical Reaction Engineering | | | | |
|-----------------------------------|--|----------------------------|---------------------------|-------------------|---------------------|
| Courses | | | | | |
| Title | | Тур | | Hrs/wk | СР |
| Chemical Reaction Engineering (Fu | ndamentals) (I 0204) | Lect | | 2 | 2 |
| Chemical Reaction Engineering (Fu | | | itation Section (large) | 2 | 2 |
| Experimental Course Chemical Eng | | | tical Course | 2 | 2 |
| Module Responsible | Prof. Raimund Horn | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Contents of the previous modules mathema | tics I-III, physical chemi | stry, technical thermody | /namics I+II as w | ell as computationa |
| Knowledge | methods for engineers. | | | | |
| Educational Objectives | After taking part successfully, students have | reached the following le | arning results | | |
| Professional Competence | | | | | |
| Knowledge | The students are able to explain basic conce | epts of chemical reaction | engineering. They are | able to point out | differences betweer |
| | thermodynamical and kinetical processes. T | The students have a str | ong ability to outline pa | arts of isotherma | and non-isotherma |
| | ideal reactors and to describe their propertie | s. | | | |
| Skills | After successful completion of the module, st | tudents are able to: | | | |
| | | | l non issthormal ideal re | | |
| | - apply different computational methods to d | imension isothermai and | i non-isothermai ideal re | actors, | |
| | - determine and compute stable operation po | pints for these reactors , | | | |
| | - conduct experiments on a lab-scale pilot pla | ants and document these | e according to scientific | guidelines. | |
| Personal Competence | | | | | |
| • | After successful completition of the lab-cour | se the students have a | strong ability to organiz | e themselfes in s | mall groups to solv |
| , | issues in chemical reaction engineering. Th | | | | |
| | their teachers. | | , | | |
| Autonomv | The students are able to obtain further | information and assess | their relevance auto | nomously. Studer | nts can apply thei |
| | knowldege discretely to plan, prepare and co | | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lu | | | | |
| Credit points | 6 | | | | |
| Course achievement | Compulsory Bonus Form | Description | | | |
| | Yes None Subject theoretical | and | | | |
| | practical work | | | | |
| Examination | Written exam | | | | |
| Examination duration and | 120 min | | | | |
| scale | | | | | |
| Assignment for the | General Engineering Science (German progra | am, 7 semester): Special | isation Process Engineer | ring: Compulsory | |
| Following Curricula | General Engineering Science (German progra | am, 7 semester): Special | isation Bioprocess Engin | eering: Compulso | ory |
| | Bioprocess Engineering: Core Qualification: C | Compulsory | | | |
| | General Engineering Science (English progra | m, 7 semester): Speciali | sation Bioprocess Engine | eering: Compulso | гy |
| | General Engineering Science (English progra | m, 7 semester): Speciali | sation Process Engineeri | ng: Compulsory | |
| | Green Technologies: Energy, Water, Climate: | Specialisation Bioresour | ce Technology: Elective | Compulsory | |
| | Process Engineering: Core Qualification: Com | pulsory | | | |

| ourse L0204: Chemical Reaction Engineering (Fundamentals) | | |
|---|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| CP | 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, 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?, 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, 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, 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 reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of a 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, mole-balance 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 ex |
|------------|---|
| Literature | 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 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 |

| Course L0244: Chemical Reaction Engineering (Fundamentals) | | |
|--|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Raimund Horn, Dr. Oliver Korup | |
| Language | DE | |
| Cycle | WiSe | |
| Content | 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 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, interversible 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 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 reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of a batch reactor, mole balance of the plug flow reactor, analogy batch reactor - plug flow reactor, design of a membrane reactor, wole balance of a con |
|------------|--|
| | of a reactor) |
| Literature | 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 |
| | 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 |

| Course L0221: Experimental | Course Chemical Engineering (Fundamentals) |
|----------------------------|--|
| Тур | Practical Course |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Raimund Horn |
| 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 M1275: Enviro | onmental Tech | nology | | | |
|-------------------------------------|--|----------------------------|---|---------------------------|----------------------|
| | | | | | |
| Courses | | | | | |
| Title | | | Тур | Hrs/wk | CP |
| Practical Exercise Environmental Te | 5, | | Practical Course Lecture | 1 2 | 1 2 |
| Environmental Technologie (L0326 | 1 | | Lecture | Z | Z |
| Module Responsible | | litt | | | |
| Admission Requirements | | | | | |
| Recommended Previous | Fundamentals of inor | ganic/organic chemistry | and biology | | |
| Knowledge | A.C | <u></u> | | | |
| | After taking part succ | cessfully, students have r | reached the following learning results | | |
| Professional Competence | | | | | |
| Knowledge | the behaviour of che | | ts obtain profound knowledge of environn nt. Students can give an overview of scie | | |
| 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 opinons in front of and against the group. | | | | |
| Personal Competence | | | | | |
| Social Competence | The students are able | e to discuss the various t | echnical and scientific tasks, both subject | -specific and multidisci | plinary. They are at |
| | to develop different a | approaches to the task as | s a group as well as to discuss their theore | etical or practical imple | mentation. |
| Autonomy | Students can indeper | ndently exploit sources a | bout of the subject, acquire the particular | knowledge and tranfer | it to new problems |
| Workload in Hours | Independent Study Ti | ime 48, Study Time in Le | cture 42 | | |
| Credit points | 3 | | | | |
| Course achievement | Compulsory Bonus | Form | Description | | |
| | Yes None | Subject theoretical | and | | |
| | | practical work | | | |
| Examination | Written exam | | | | |
| Examination duration and | 1 hour | | | | |
| scale | | | | | |
| Assignment for the | General Engineering | Science (German progra | m, 7 semester): Specialisation Process En | gineering: Elective Com | npulsory |
| Following Curricula | | | m, 7 semester): Specialisation Bioprocess | | |
| | | | m, 7 semester): Specialisation Energy and | l Enviromental Enginee | ring: Compulsory |
| | | ng: Core Qualification: El | | | |
| | 5,7 | 5 5 | Qualification: Compulsory | | |
| | | | n, 7 semester): Specialisation Bioprocess | | |
| | | | n, 7 semester): Specialisation Energy and | - | |
| | | | n, 7 semester): Specialisation Process Eng | ineering: Elective Com | puisory |
| | Process Engineering: | Core Qualification: Elect | ive compulsory | | |

| Course L1387: Practical Exercise Environmental Technology | | |
|---|--|--|
| Тур | Practical Course | |
| Hrs/wk | 1 | |
| CP | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Martin Kaltschmitt, Dr. Isabel Höfer | |
| Language | DE | |
| Cycle | SoSe | |
| Content | The practical course Environmental Engineering currently consists of 6 experiments, which deal with the different focal points of environmental engineering in the areas of air, water, soil, environment, biomass and noise. The following experiments are carried out for this purpose: Determination of the calorific value of biomass, soil purification, waste water treatment, noise emissions, plastic waste, biowaste. Translated with www.DeepL.com/Translator (free version) 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 | | |
| Literature | | |

| Course L0326: Environmenta | I Technologie |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Martin Kaltschmitt, Dr. Isabel Höfer |
| 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 | | Тур | Hrs/wk | СР |
| Bioprocess Engineering - Advanceo Bioprocess Engineering - Advanceo | | Lecture Recitation Section (small) | 2 | 4 2 |
| | | Reclation Section (Smail) | 2 | 2 |
| Module Responsible | | | | |
| Admission Requirements Recommended Previous | None Content of module "Biochemical Engineering I | 18 | | |
| Knowledge | content of module biochemical Engineering i | | | |
| | After taking part successfully, students have r | eached the following learning results | | |
| Professional Competence | | | | |
| - | After successful completion of this module, stu | idents should be able to | | |
| 5 | | | | |
| | describe and explain different kinetic approximation | pproaches for growth and substrate-uptake | | |
| | identification of scientific problems with | a concrete inductrial use (cultivation of microa | conicme and ma | mmalian colle) |
| | Identification of scientific problems with | n concrete industrial use (cultivation of microor | ganisms and ma | mmalian celis) |
| | describe and explain important down | streaming steps for proteins and their applic | ation as well as | basic immobilizat |
| | methods | | | |
| | | | | |
| | | | | |
| Skills | After successful completion of this module, stu | idents should be able to | | |
| | to identify scientific questions or pass | ible practical problems for concrete indus | trial application | c (og cultivation |
| | microorganisms and animal cells) and to form | | | s (eg cultivation |
| | | | | |
| | - To assess the application of scale-up criteria | for different types of bioreactors and processe | es and to apply th | nese criteria to giv |
| | problems (anaerobic , aerobic or microaerobic | ally) | | |
| | | | | |
| | - to formulate questions for the analysis and o | ptimization of real biotechnological production | processes appro | priate solutions , |
| | | | | |
| | | ration, the regeneration of reduction equivalen | nts , and the gro | wth inhibition of t |
| | behavior of microorganisms and to the total fe | rmentation process qualitatively | | |
| | | | | |
| | | nd solve them to determine the kinetic parar | neters of differer | nt approaches and |
| | calculate immobilization and activity yields , | | | |
| | | | | |
| | to select process control strategies (batch , f | ed-batch , continuity) appropriately and to cal | culate basic type | es and evaluate the |
| | | | | |
| Demonstration of the second | | | | |
| Personal Competence | After completion of this module participants s | hould be able to debate technical questions in | small toams to d | nhanco tho ability |
| Social competence | take position to their own opinions and increas | | Sinai teans to e | interice the ability |
| | take position to their own opinions and increas | | | |
| | | | | |
| Autonomy | After completion of this module participants a | re able to aquire new sources of knowledge ar | id apply their kno | wledge to previou |
| | unknown issues and to present these. | | | |
| Weedle ed by Using | la den en deut Chudu Time 124. Chudu Time in L | turn 50 | | |
| Workload in Hours | | ecture ob | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | Written exam | | | |
| Examination duration and scale | | | | |
| Assignment for the | General Engineering Science (German prograr | n 7 semester): Specialisation Rioprocess Engin | eering: Compuls | ory |
| - | Bioprocess Engineering: Core Qualification: Co | | .compuls | <i>j</i> |
| . showing curriculu | | , 7 semester): Specialisation Bioprocess Engine | eering: Compulso | ry |
| | | Specialisation Bioresource Technology: Elective | | - |
| | Technomathematics: Specialisation III. Engine | | . , | |

| Course L1107: Bioprocess En | igineering - Advanced |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. An-Ping Zeng |
| 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 |

| Course L1108: Bioprocess En | ngineering - Advanced |
|-----------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. An-Ping Zeng |
| 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 |

| Courses | | | | |
|----------------------------------|--|--|------------------------------------|--|
| Title | Ту | /p | Hrs/wk | СР |
| Environmental Assessment (L0860) | | cture | 2 | 2 |
| Environmental Assessment (L1054) |) Rei | citation Section (small) | 1 | 1 |
| Module Responsible | Prof. Martin Kaltschmitt | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Fundamentals of inorganic/organic chemistry and biology | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the following le | learning results | | |
| Professional Competence | | | | |
| Knowledge | With the completion of this module the students acquire in-dep environmental problems which might occur from production proces about the methodological diversity and are competent in dealing wi impacts. Besides the students are able to estimate the complexity difficulties with their measurement. | sses, projects or construction ith different methods and inst | measures. The truments to asse | y have knowled ess environment |
| Skills | The students are able to select a suitable method for the respective can develop suitable solutions for managing and mitigating environ out Life Cycle Impact Assessments independently and can apply t After finishing the course the students have the competence t environmental impacts. | nmental problems in a busine the software programs Open | ss context. They LCA and the da | are able to car tabase Ecolnver |
| Personal Competence | | | | |
| Social Competence | The students are able to discuss the various technical and scientific to develop jointly different solutions and to discuss their theoreti topics, the students receive insights into the multi-layered issues of Their sensitivity and consciousness towards these subjects are rai social responsibilities in their role as engineers. | ical or practical implementat f the environment protection | tion. Due to the and the concept | e selected lecture selected lecture selected lecture selected lecture selected lecture selected sele |
| Autonomy | The students learn to research, process and present a scientific to scientific work. They can solve an environmental problem in a busing | | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | | | | |
| Examination duration and | | | | |
| scale | | | | |
| | General Engineering Science (German program, 7 semester); Specia | alisation Process Engineering. | Elective Compu | lsorv |
| j | General Engineering Science (German program, 7 semester): Specia General Engineering Science (German program, 7 semester): Specia | 5 | | , |
| J | General Engineering Science (German program, 7 semester): Specia | | | |
| | Bioprocess Engineering: Core Qualification: Elective Compulsory | | 2 | |
| | Energy and Environmental Engineering: Core Qualification: Compuls | sory | | |
| | General Engineering Science (English program, 7 semester): Special | - | g: Elective Com | pulsory |
| | General Engineering Science (English program, 7 semester): Special | | | |
| | General Engineering Science (English program, 7 semester): Special Process Engineering: Core Qualification: Elective Compulsory | lisation Energy and Enviromen | ntal Engineering | : Compulsory |

| Course L0860: Environmenta | I 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 | WiSe/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: Environmenta | Il Assessment |
|----------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Martin Kaltschmitt, Dr. Anne Rödl |
| Language | DE |
| Cycle | WiSe |
| 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 |
| | |

| Courses | | | | | | |
|---|------------------------------|---------------------------------------|------------------------|------------------------------|------------------|---------------------|
| Гitle | | | | Гур | Hrs/wk | СР |
| Process and Plant Engineering I (L0095) | | | | Lecture | 2 | 2 |
| Process and Plant Engineering I (LO | 096) | | I | Recitation Section (large) | 1 | 2 |
| Process and Plant Engineering I (L1 | 214) | | I | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Mirko Skiborows | ki | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | unit operation of ther | mal an dmechanical sep | aration processes | | | |
| Knowledge | chemical reactor eing | ineering | | | | |
| Educational Objectives | After taking part succ | essfully, students have i | reached the following | g learning results | | |
| Professional Competence | | | | | | |
| Knowledge | students can: | | | | | |
| | classify and formulate | e blobal balance equatio | ns of chemical proce | sses | | |
| | - | | | | | |
| | specify linear compor | nent equations of comple | ex chemical processe | 2S | | |
| | explain linear regress | ion and data reconcilliat | ion problems | | | |
| | explain pfd-diagrams | | | | | |
| Skills | students are capable of | | | | | |
| | - formulation of mass | and energy balance equ | ations and estimatio | on of product streams | | |
| | - estimation of compo | onent streams of chemic | al plants using linear | component balance model | s | |
| | - solution of data reco | oncilliation tasks | | | | |
| | - conduction of proce | ss synthesis | | | | |
| | - economic evaluatior | n of processes and the e | stimation of producti | on costs | | |
| Personal Competence | | | | | | |
| Social Competence | | | | | | |
| Autonomy | | | | | | |
| Workload in Hours | Independent Study Ti | me 124, Study Time in L | ecture 56 | | | |
| Credit points | 6 | | | | | |
| Course achievement | Compulsory Bonus Yes 10 % | Form | Description | | | |
| | Yes 10 % | Subject theoretical practical work | and | | | |
| Examination | Written exam | practical work | | | | |
| Examination duration and | | es and books | | | | |
| scale | 120 Mill. lectures not | | | | | |
| Assignment for the | General Engineering | Science (German progra | m. 7 semester): Spe | cialisation Process Engineer | ina: Compulsory | |
| Following Curricula | | | | cialisation Bioprocess Engin | | ory |
| 5 | | ng: Core Qualification: Co | | , , | 5 1 | , |
| | | - | | ialisation Bioprocess Engine | ering: Compulsor | ry |
| | General Engineering | Science (English prog | ram, 7 semester): | Specialisation Energy and | Enviromental E | ingineering: Electi |
| | Compulsory | | , | | | |
| | | Science (English progran | n, 7 semester): Spec | ialisation Process Engineeri | ng: Compulsory | |
| | | | | ource Technology: Elective | | |
| | Process Engineering: | | | 5, | | |

| Course L0095: Process and P | lant Engineering I |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Mirko Skiborowski |
| Language | DE |
| Cycle | SoSe |
| Content | Introduction Structure and operation of production plants Operational business process Technical process design Motivation and targets of process development Life cycle of production plants Engineering methods and tools Mass and energy balances Strategies of process synthesis Graphical representation of processes Multidimensional regression |

| 1 | Date reconciliation and date validation |
|------------|---|
| | 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 |
| | |
| Literature | S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679 |
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| | F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76 |
| | |

| Course L0096: Process and P | ourse L0096: Process and Plant Engineering I | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Prof. Mirko Skiborowski, Dr. Thomas Waluga | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Course L1214: Process and F | ourse L1214: Process and Plant Engineering I | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 1 | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Prof. Mirko Skiborowski, Dr. Thomas Waluga | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | | | |
|---------------------------------------|--|-----------------------------|---|-------------------|------------------|--------------------|
| Title | | | Тур | | Hrs/wk | СР |
| Particle Technology I (L0434) | | | Lecture | | 2 | 3 |
| Particle Technology I (L0435) | | | Recitation Sect | | 1 | 1 |
| Particle Technology I (L0440) | | | Practical Cours | e | 2 | 2 |
| Module Responsible | | h | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | keine | | | | | |
| Knowledge | | | | | | |
| Educational Objectives | After taking part suc | ccessfully, students have | reached the following learning res | ults | | |
| Professional Competence | | | | | | |
| Knowledge | After successful con | mpletion of the module st | udents are able to | | | |
| | name and ex | plain processes and unit | -operations of solids process engin | eering | | |
| | | | itions and to discuss their bulk pro | - | | |
| | endidetenize | paraleles, paralele alsense | | | | |
| | | | | | | |
| Skills | Students are able to | 0 | | | | |
| | | | | | | |
| | choose and d | lesign apparatuses and p | rocesses for solids processing acco | rding to the des | ired solids prop | erties of the prod |
| | | | vior in solids processing steps | | | |
| | document the | eir work scientifically. | | | | |
| Personal Competence | | | | | | |
| | The students are a | able to discuss scientific | topics orally with other students | or scientific per | sonal and to d | develop solutions |
| | technical-scientific i | | | | | |
| Autonomy | | | ions regarding solid particles indep | pendently. | | |
| | | | | | | |
| Workload in Hours | | Time 110, Study Time in | Lecture 70 | | | |
| Credit points | 6 Compulsory Bonus | Form | Description | | | |
| Course achievement | Yes None | Written elaboration | sechs Berichte (pro Versuch | ein Bericht) à 5- | -10 Seiten | |
| Examination | Written exam | | | , | | |
| Examination duration and | - | | | | | |
| scale | | | | | | |
| Assignment for the | General Engineering | g Science (German progra | am, 7 semester): Specialisation Pro | cess Engineering | a: Compulsory | |
| Following Curricula | 5 | | am, 7 semester): Specialisation Bio | | | orv |
| · · · · · · · · · · · · · · · · · · · | | | am, 7 semester): Specialisation G | | | - |
| | Engineering: Electiv | | . , , | | | |
| | | | am. 7 semester): Specialisation En | ergy and Environ | nental Enginee | rina: Compulsorv |
| | General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsor Bioprocess Engineering: Core Qualification: Compulsory | | | | | 3 j |
| | | - | Qualification: Elective Compulsory | / | | |
| | | | | | ing: Compulso | ry |
| | General Engineering Science (English program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory | | | | | |
| | | a Science (English progra | m. 7 semester): Specialisation Ene | rgy and Envirom | ental Engineer | ing: Compulsory |
| | General Engineering | | | | - | ing: Compulsory |
| | General Engineering General Engineering | g Science (English progra | m, 7 semester): Specialisation Ene m, 7 semester): Specialisation Proc Specialisation Water: Elective Cor | cess Engineering | - | ing: Compulsory |

| Course L0434: Particle Techn | nology I |
|------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 |
| | 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 | |
| CP | 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 Tech | nology I |
|-----------------------------|--|
| Тур | Practical Course |
| Hrs/wk | 2 |
| CP | 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. |

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.

Module M0708: Electrical Engineering III: Circuit Theory and Transients

| Courses | | | | |
|--------------------------|--|--|--------------------|------------------------|
| Title | | Тур | Hrs/wk | СР |
| Circuit Theory (L0566) | | Lecture | 3 | 4 |
| Circuit Theory (L0567) | | Recitation Section (small) | 2 | 2 |
| Module Responsible | Prof. Alexander Kölpin | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Electrical Engineering I and II, Mathematics I and II | | | |
| Knowledge | | | | |
| | | | | |
| Educational Objectives | After taking part successfully, students have reache | d the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to explain the basic methods for | calculating electrical circuits. They know | v the Fourier ser | ies analysis of linear |
| | networks driven by periodic signals. They know the | e methods for transient analysis of linea | r networks in ti | me and in frequency |
| | domain, and they are able to explain the frequency | pehaviour and the synthesis of passive tw | o-terminal-circui | ts. |
| | | | | |
| | | | | |
| Skills | The students are able to calculate currents and ve | | | |
| | periodic signals. They are able to calculate transient | | 5 | |
| | respective transient behaviour. They are able to a | nalyse and to synthesize the frequency | behaviour of p | assive two-terminal- |
| | circuits. | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| | group. | | | |
| | | | | |
| Autonomy | The students are able to find out the required meth | ads for solving the given practice problem | ne Possibilitios a | ro givon to tost thoir |
| Autonomy | knowledge during the lectures continuously by n | | | |
| | educational objectives. They can link their gained kr | | | |
| | , | | | |
| | | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture | 70 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 150 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, | 7 semester): Specialisation Mechanica | l Engineering, | Focus Mechatronics |
| Following Curricula | Compulsory | | | |
| | General Engineering Science (German program, 7 se | | ering: Compulsor | у |
| | Electrical Engineering: Core Qualification: Compulso | | | |
| | General Engineering Science (English program, 7 se | | | |
| | General Engineering Science (English program, | / semester): Specialisation Mechanica | Engineering, | Focus Mechatronics |
| | Compulsory | en II. Methemetice C. Fraincarian C. | - Elective Com | Jeen |
| | Computational Science and Engineering: Specialisat | | | льогу |
| | Computational Science and Engineering: Specialisat | on Engineering Sciences: Elective Compu | isory | |
| | Mechatronics: Core Qualification: Compulsory | cionco: Electivo Compulson | | |
| | Technomathematics: Specialisation III. Engineering S | cience. 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, Dr. Fabian Lurz |
| 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 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Arne Jacob, Dr. Fabian Lurz |
| Language | DE |
| Cycle | WiSe |
| Content | see interlocking course |
| Literature | siehe korrespondierende Lehrveranstaltung |
| | see interlocking course |

| TitleTypHrs/wkCPComputer Engineering (L0321)Lecture34 | Courses | | | | |
|---|------------------------------|---|---|--|--|
| Image: Comparison (0.022) Im | | | Typ | Hrs/wk | CP |
| Module Responsible (Port Links is all Additional Requirements None Recommendated Provides Biocentimed Provides Recommendated Provides Recommendated Provides Recommendated Provides Recommendated Provides Recommendated Provides Recommendated Compatibility Statistics None Recommendation | Computer Engineering (L0321) | | | | |
| Admission Requirements Recommended Privates Non- Recommended Privates Extractional Objectives After taking pert successfully, students have reached the following learning results Professional Competence Knowledge Introduct data with the foundations of the functionality of computing systems. It covers the layers from the assembly programming down to gates. The module includes the following topics: Introductional sign: Class, Boolean adjetra, Boolean functions, hardware synthesis, combinational networks Equivalence of the synthesis, Sonthalt, and the synthesis, combinational networks Introductional sign: Class, Boolean adjetra, Boolean functions, hardware synthesis, combinational networks Equivalence of the synthesis, Sonthalt, and s | Computer Engineering (L0324) | | Recitation Section (small) | 1 | 2 |
| Recommended Previous Buil: Increasing in decidical engineering Professional Competence Reconstructional Dijectives After taking parts taccessfully, students have reached the following teaming results Professional Comparing Reconstruction Increasing and the taking parts taccessfully, students have reached the following teaming results Professional Comparing Reconstruction Increasing and the taking comparing approximation of the functionality of comparing systems. It covers the layers from the assembly programming date to gates. The module includes the following teaming results Included: Included: Incl | Module Responsible | Prof. Heiko Falk | | | |
| Non-windpa Instrumental end of the foundation of the foundatio | Admission Requirements | None | | | |
| Educational Objective After taking parts accorduly, students have reached the following learning results Professional Computing Resolution This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly programming down to gates. The module includes the following inputs: Introduction Combinational logic: Following Longenza Combinational logic: Following Longenza Combinational logic: Following Longenza Combinational logic: Following Longenza Extended Logic Endocuments Extended Logic Endocumen | Recommended Previous | Basic knowledge in electrical engineering | | | |
| Professional Competence Knowledge This montule deals with the foundations of the functionality of computing systems. It exvers the layers from the assembly programming down to gates. The module includes the following topics: Introduction Compate antimuted: Integer addition, subtraction, mutablication and division Beace of compater antimetics. These addition, subtraction, mutablication and division Beace of compater antimetics. These addition, subtraction, mutablication and division Beace of compater antimetics. These addition, subtraction, mutablication and division Beace of compater antimetics. These addition, subtraction, mutablication and division Beace of compater antimetics. Beace analyse, New Bigle scycle architecture, pipelining Research of compater systems. From the architecture programming models. Mits Subjectific and individual computers can be built beace Beace and the other antimetics. They are able to distinguish between and to explain the different abstraction layer than one base built beace on the distinguish between and to explain the different abstraction layer than models. The subtracts are able to judge the introdynetices between a physical componence Beace and the other accented on a In particular, they shall understand the companiences built beace on the impact that these law statuction layers from the assembly impaged adown to gates. The substate are able to judge the introdynet componence built beace on the assemble for agreed advise of the propose feasible options. Personal Compatero Social Compatero Suddents are able to solve similar problems alone or in a group and to prosent the results accordingly. Autonomy Students are able to acquire new knowledge from specific literature and to aphree assemble of participation and the other antipation approxim. J semisteris Specialisation Biopering Computery General Engineering Science (German program. 7 semisteris Specialisation Mechanical Engineering, Focus Mechanic Computery General Engineering Science (German program. 7 semisteris Speciali | Knowledge | | | | |
| Nonvelocity This module deals with the foundations of the functionality of compating systems. It covers the layers from the assembly programming down to gates. The module includes the following topics: Initioaction Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesis, combinational networks Segurate altitudes: Linteger addition, subtraction, mutiplication and division Basics of computer architecture: Programming models, MPS single-cycle architecture, pipelining Memore: Memory hierarchies, SMAD, MDA, caches The students paretexic computer systems. The students are able to oldstipudet between and to explain the different abstraction layers. Ann highly specific and individual computers can be built based Compation of computer systems. The students are able to oldstipudet between and to explain the different abstraction layers. The individual computers can be built based Parsonal Competence Social Competence Sudents are able to solve similar problems alone on in a group and to present the musils accordingly. Parsonal Competence Social Competence Sudents are able to solve similar problems alone on in a group and to present the musils accordingly. Parsonal Competence Social Competence Social Competence Social Competence Social Competence Social Competence Social Competence Social Competence Social Competence So | Educational Objectives | After taking part successfully, students have reached the | following learning results | | |
| Personal Competence Social Competence Social Competence Social Competence Sequence in logics Fight Repr. submittee in the second multiplication and division Between the second division Between the second division of the second division of the second division of the second division Between the second division Between the second division of the second division of the second division Between the second division Between the second division of the second division of the second division Between the second division Second division of computer systems from the architects preservice i.e. they identify the internal hours and the oblig between and to second division of computer systems. The students are able to division between and to explain the different abstraction layer from division and the oblig between and the software executed on the making. The second division divisi | Professional Competence | | | | |
| Combinational logic: Gates, Bookan algebra, Bookan functions, hardware synthesis, combinational networks Sequential logic: Floreport, authoretics, systematic hardware design T-chronological foundations Computer arthmetic: hereport authoretics, multiplication and dividion Basics of computer arthmetic: Floreport, Bookan, MPS single-cycle architecture, pipelining Memorites, Memory herarches, SAMA, DAAA, caches Heredocati. Vio from the perspective of the CPU, principles of passing data, point-to-point connections, busses Setils The students perceive computer systems from the architectry perspective, Le., they identify the internal antiture and the pipe composition of computer systems. They are able to didpinguish between and to explain the different abstraction lays today's computing systems. They are able to didpinguish between and to explain the different abstraction lays today's computing systems. The maskes and circuits up to complete processors. After successful completion of the models. The submethal are able to judge the interdependencies between a physical com system and the software executed on 1. In particular, they shull undenstand the consequences that the exalise to explore the impact that these low abstraction levels have on an entire system's performance and to propose feesible options. Personal Competence Social Competence Sudents are able to acquire new inoviedge from specific literature and to associate this inoviedge with other classes. Workfoad In Hears: Josephrometry Substrates of course and labs Social Course achievements Software property from in Lecture 36 Exercises Exercises Software property from 30 Signature and property. Specialization Manufers Control, Study Time 24, Study Time 14, Stu | Knowledge | | | | |
| composition of computer systems. The students can analyze, how highly specific and individual computers can be built based collection of few and simple components. They are able to distinguish belween and to explain the different abstraction layer today's computing systems - from gates and circuits up to complete processors. After successful completion of the mobule, the students are able to judge the interdependencies between a physical com system and the software socureted on it. In particular, they shall understand the consequences that the execution of abitivation on the hardware-entric abstraction layers from the assembly language down to gates. This way, they will be enabled to eval the impact that less low abstraction levels have on an entire system's performance and to propose feasible options. <i>Autonomy</i> Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. Workload In Hows independent Study Time 224, Study Time in Lecture 56 Control 1990 Second 1990 Examination duration and 30 minutes, contents of course and lais Examination duration and 30 minutes, contents of course and lais Course achievenut Following Currier Following Currier Following Currier Following Currier General Engineering Science (German program, 7 semester): Specialisation Computer Science: Computsory General Engineering Science (German program, 7 semester): Specialisation Nava Architecure: compulsory General Engineering Science (German program, 7 semester): Specialisation Nava Architecure: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Matchat Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Matchat Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Matchat Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Matchat Com | | Combinational logic: Gates, Boolean algebra, Boole Sequential logic: Flip-flops, automata, systematic h Technological foundations Computer arithmetic: Integer addition, subtraction, Basics of computer architecture: Programming more Memories: Memory hierarchies, SRAM, DRAM, cach | ardware design multiplication and division dels, MIPS single-cycle architecture, es | pipelining | |
| 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 Course achievement Remothory Born Form Description Remothory Born Form Description Examination duration and So minutes, contents of course and labs Social Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Mechanical Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Mechanical Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Mechanical Engineering: Compulsory General Engineering Science (German prog | Skills | composition of computer systems. The students can anal collection of few and simple components. They are able today's computing systems - from gates and circuits up to After successful completion of the module, the students system and the software executed on it. In particular, the on the hardware-centric abstraction layers from the asse | yze, how highly specific and individ to distinguish between and to exp o complete processors. are able to judge the interdepend ey shall understand the consequence mbly language down to gates. This | ual computers car lain the different i dencies between i ces that the execu way, they will be | h be built based of abstraction layers a physical compu- tion of software enabled to evalu |
| 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 Hous Independent Study Time 124, Study Time in Lecture 56 Course achievement Computery Items Items Research 10 % Excercises Examination duration and Scale Solutions, contents of course and labs Examination duration and Scale General Engineering Science (German program, 7 semester): Specialisation Navquita Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Navquita Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Navquita Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering. Focus Mechatric Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Mechatric Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Mechatric Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering. Focus Mechatric Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanica | | | | | |
| Autonom 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 Course achieveneit Computery Benue Yerm Versition Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. Examination duration and 30 minutes, contents of course and labs scale General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mendical Engineering; Compulsory General Engineering Science (German program, 7 semester): Specialisation Mendical Engineering, Focus Micrature Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micrature Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micrature Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Micrature Compulsory General Engineering Sc | | | | a setting and a | |
| Workload in Hours Independent Study Time 124, Study Time in Lecture 56 Course achievement Computery Teorus Porm Description Course achievement Computery Teorus Porm Description Examination Written exam Examination and 90 minutes, contents of course and labs scale Examination Gurricula General Engineering Science (German program, 7 semester): Specialisation Servers Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioercical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioercical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Envinomental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechater Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechater Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechater Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechater Compulsory < | Social Competence | Students are able to solve similar problems alone or in a g | group and to present the results acc | cordingly. | |
| Credit points 6 Course achievement Computary Banus Form Description Yes 10 % Excercises Examination Examination duration and 90 minutes, contents of course and labs scala Assignment for the General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineerin | Autonomy | Students are able to acquire new knowledge from specific | literature and to associate this kno | wledge with othe | classes. |
| Credit points 6 Course achievement Computery Bonus Form Description Yes 10 % Excercises Examination Examination duration and 90 minutes, contents of course and labs scale Assignment for the General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bioredical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineerin | | | | | |
| Course achievement Computery Bernix Form Description Yes 10 % Extercises Examination Examination duration and scale 30 minutes, contents of course and labs 30 Assignment for the Following Curricula 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 Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Bergy and Environmental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Dercess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatre Compulsory | | | | | |
| Yes 10 % Excercises Examination Written exam Examination duration and social 30 minutes, contents of course and labs scale General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory Following Curricula General Engineering Science (German program, 7 semester): Specialisation Bioprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): 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 Mecharic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mecharic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mecharic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering: Compulsory | | | tion | | |
| Examination duration and scale 90 minutes, contents of course and labs Assignment for the Following Curricula 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 Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: 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 Mechatro Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatro Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Alterat Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester) | course achievement | | | | |
| scale Assignment for the Following Currical 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 Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatro General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomeche Gompulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst | Examination | Written exam | | | |
| Assignment for the Following Curricula 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 Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatr Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatr Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatr Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mecha Engineering Science (German program, 7 semester): Specialisation Mechanical Eng | Examination duration and | 90 minutes, contents of course and labs | | | |
| Following CurriculGeneral Engineering Science (German program, 7 semester): Specialisation Bloprocess Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Energy and Environental Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatro Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatro Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering: compulsoryGeneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering: compulsoryGeneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering: CompulsoryGeneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst CompulsoryGeneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst CompulsoryGeneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst CompulsoryGeneral Engineering Scienc | scale | | | | |
| General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical 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: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatro Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatro Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Alercate Specialisation Mechanical Engineering, Focus Alercate Sys Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Alercate Sys Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mecha Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Com | Assignment for the | General Engineering Science (German program, 7 semest | er): Specialisation Computer Science | e: 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 Mechanical Engineering, Focus Mechatr General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatr Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatr Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatr Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineer | Following Curricula | General Engineering Science (German program, 7 semest | er): Specialisation Bioprocess Engir | eering: Compulso | ry |
| General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatro Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatro Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Alercraft Sys Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Alercraft Sys Engineering Science: (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science: (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering Science (German program, 7 semester): Specialisation Electrical Eng | | General Engineering Science (German program, 7 semest | er): Specialisation Naval Architectu | re: 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 Mechatre Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomeche Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mecha Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Compulsory Data Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation | | General Engineering Science (German program, 7 semest | er): Specialisation Electrical Engine | ering: Compulsory | |
| General Engineering Science (German program, 7 semester): Specialisation Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatro Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomeche Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering Sciences (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mecha Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Computer Science: Core Qualification: Compulsory Electrical Engineering Science (German 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 Electrical Engineering: Compulsory | | General Engineering Science (German program, 7 semest | er): Specialisation Biomedical Engir | eering: Compulso | ry |
| General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatro Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Data Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory Betectrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory | | General Engineering Science (German program, 7 semest | er): Specialisation Energy and Envir | omental Engineer | ing: Compulsory |
| Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecha Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mecha Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mecha Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory | | General Engineering Science (German program, 7 semest | er): Specialisation Process Engineer | ring: Compulsory | |
| General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systengineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systengineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Science: 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 Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systematic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systematic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systematic Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systematic Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (German program, 7 seme | | Conoral Engineering Science (Corman program 7 c) | | al Engineering, F | ocus Mechatron |
| Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mecha Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Computery General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory | | | emester): Specialisation Mechanic | | |
| Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mecha Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory | | Compulsory General Engineering Science (German program, 7 se | | al Engineering, F | ocus Biomechan |
| General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Develop and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory | | Compulsory General Engineering Science (German program, 7 se Compulsory General Engineering Science (German program, 7 sen Engineering: Compulsory | mester): Specialisation Mechanica | Engineering, Foc | us Aircraft Syste |
| General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy SystCompulsoryGeneral Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy SystCompulsoryGeneral Engineering Science (German program, 7 semester): Specialisation Civil Engineering: CompulsoryComputer Science: Core Qualification: CompulsoryData Science: Core Qualification: Elective CompulsoryElectrical Engineering: Core Qualification: CompulsoryGeneral Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: CompulsoryGeneral Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: CompulsoryGeneral Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory | | Compulsory General Engineering Science (German program, 7 se Compulsory General Engineering Science (German program, 7 sen Engineering: Compulsory General Engineering Science (German program, 7 se Engineering Sciences: Compulsory | mester): Specialisation Mechanica nester): Specialisation Mechanical emester): Specialisation Mechani | Engineering, Foc | us Aircraft Syste Focus Materials |
| General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst Compulsory General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory | | Compulsory General Engineering Science (German program, 7 ser Compulsory General Engineering Science (German program, 7 sen Engineering: Compulsory General Engineering Science (German program, 7 s Engineering Sciences: Compulsory General Engineering Science (German program, 7 semesi Engineering: Compulsory General Engineering Science (German program, 7 semesi | mester): Specialisation Mechanica nester): Specialisation Mechanical emester): Specialisation Mechani ter): Specialisation Mechanical Engi | Engineering, Foc cal Engineering, neering, Focus Th | us Aircraft Syste Focus Materials eoretical Mechan |
| Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory | | Compulsory General Engineering Science (German program, 7 ser Compulsory General Engineering Science (German program, 7 sen Engineering: Compulsory General Engineering Science (German program, 7 s Engineering Sciences: Compulsory General Engineering Science (German program, 7 semesi Engineering: Compulsory General Engineering Science (German program, 7 semesi and Production: Compulsory General Engineering Science (German program, 7 semesi | emester): Specialisation Mechanica nester): Specialisation Mechanical emester): Specialisation Mechani ter): Specialisation Mechanical Engi ster): Specialisation Mechanical Eng | Engineering, Foc cal Engineering, neering, Focus Th ineering, Focus P | us Aircraft Syste Focus Materials eoretical Mechan roduct Developm |
| Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory | | Compulsory General Engineering Science (German program, 7 ser Compulsory General Engineering Science (German program, 7 sen Engineering: Compulsory General Engineering Science (German program, 7 sen Engineering Sciences: Compulsory General Engineering Science (German program, 7 seness Engineering: Compulsory General Engineering Science (German program, 7 seness and Production: Compulsory General Engineering Science (German program, 7 seness and Production: Compulsory General Engineering Science (German program, 7 seness Compulsory General Engineering Science (German program, 7 seness) | emester): Specialisation Mechanica nester): Specialisation Mechanical emester): Specialisation Mechanical ter): Specialisation Mechanical Engi ster): Specialisation Mechanical Engi nester): Specialisation Mechanical | Engineering, Foc cal Engineering, neering, Focus Th ineering, Focus P Engineering, Focu | us Aircraft Syste Focus Materials eoretical Mechan roduct Developm us Energy System |
| General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Civil Engineering: Compulsory | | Compulsory General Engineering Science (German program, 7 ser Compulsory General Engineering Science (German program, 7 sen Engineering: Compulsory General Engineering Science (German program, 7 sen Engineering Sciences: Compulsory General Engineering Science (German program, 7 seness Engineering: Compulsory General Engineering Science (German program, 7 seness and Production: Compulsory General Engineering Science (German program, 7 seness and Production: Compulsory General Engineering Science (German program, 7 seness Compulsory General Engineering Science (German program, 7 seness Compulsory General Engineering Science (German program, 7 seness | emester): Specialisation Mechanica nester): Specialisation Mechanical emester): Specialisation Mechanical ter): Specialisation Mechanical Engi ster): Specialisation Mechanical Engi nester): Specialisation Mechanical nester): Specialisation Mechanical | Engineering, Foc cal Engineering, neering, Focus Th ineering, Focus P Engineering, Focu Engineering, Focu | us Aircraft Syste Focus Materials eoretical Mechan roduct Developm us Energy Syster |
| | | Compulsory General Engineering Science (German program, 7 ser Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 ser Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 ser and Production: Compulsory General Engineering Science (German program, 7 ser Compulsory General Engineering Science (German program, 7 ser Computer Science: Core Qualification: Compulsory | emester): Specialisation Mechanica nester): Specialisation Mechanical emester): Specialisation Mechanical ter): Specialisation Mechanical Engi ster): Specialisation Mechanical Engi nester): Specialisation Mechanical nester): Specialisation Mechanical | Engineering, Foc cal Engineering, neering, Focus Th ineering, Focus P Engineering, Focu Engineering, Focu | us Aircraft Syste Focus Materials eoretical Mechan roduct Developm us Energy Syste |
| | | Compulsory General Engineering Science (German program, 7 ser Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 ser Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 ser and Production: Compulsory General Engineering Science (German program, 7 ser Compulsory General Engineering Science (German program, 7 ser Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 serest | emester): Specialisation Mechanica nester): Specialisation Mechanical emester): Specialisation Mechanical ter): Specialisation Mechanical Engi ster): Specialisation Mechanical Engi nester): Specialisation Mechanical nester): Specialisation Mechanical er): Specialisation Civil Engineering | Engineering, Foc cal Engineering, neering, Focus Th ineering, Focus P Engineering, Focu Engineering, Focu : Compulsory | us Aircraft Syste Focus Materials eoretical Mechar roduct Developm us Energy Syste |

| | General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory |
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| | General Engineering Science (English program, 7 semester): Specialisation Computer Science: 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 |
| 1 | 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 |
| i | 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 Naval Architecture: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory |
| | Computational Science and Engineering: Core Qualification: Compulsory |
| 1 | Mechatronics: Core Qualification: Compulsory |
| - | Technomathematics: Specialisation II. Informatics: Elective Compulsory |

| Course L0321: Computer Engineering | | |
|------------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| CP | 4 | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE/EN | |
| 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 Eng | ourse L0324: Computer Engineering | | |
|----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 1 | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Prof. Heiko Falk | | |
| Language | DE/EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | |
|--|---|---|---|--|
| Title | | Тур | Hrs/wk | СР |
| Theoretical Electrical Engineering I Theoretical Electrical Engineering I | - | Lecture Recitation Section (small) | 3 2 | 5 1 |
| | Prof. Christian Schuster | | | |
| Admission Requirements | | | | |
| Recommended Previous Knowledge | Basic principles of electrical engineering and ac | vanced mathematics | | |
| Educational Objectives | After taking part successfully, students have re- | ached the following learning results | | |
| Professional Competence Knowledge | Students can explain the fundamental formula: They can explicate the principal behavior of sources. They can describe the properties of fields. The students are aware of applications f these. | electrostatic, magnetostatic, and current complex electromagnetic fields by means | density fields with of superposition o | regard to respective f solutions for simp |
| Skills | Students can apply Maxwell's Equations in integral notation in order to solve highly symmetrical, time-independen electromagnetic field problems. Furthermore, they are capable of applying a variety of methods that require solving Maxwell' Equations for more general problems. The students can assess the principal effects of given time-independent sources of fields ar analyze these quantitatively. They can deduce meaningful quantities for the characterization of electrostatic, magnetostatic, an electrical flow fields (capacitances, inductances, resistances, etc.) from given fields and dimension them for practical applications | | | |
| Personal Competence Social Competence | Students are able to work together on subject i during exercise sessions). | elated tasks in small groups. They are abl | e to present their re | esults effectively (e. |
| Autonomy | Students are capable to gather necessary inform able to continually reflect their knowledge by m lectures and exercises that are related to the ex- learning process. They are able to draw connec- lectures (e.g. Electrical Engineering I, Linear Alg | eans of activities that accompany the lect kam. Based on respective feedback, studer ections between their knowledge obtained | ure, such as short o its are expected to | ral quizzes during tl adjust their individu |
| Workload in Hours | Independent Study Time 110, Study Time in Le | cture 70 | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 90-150 minutes | | | |
| Assignment for the Following Curricula | General Engineering Science (German program Electrical Engineering: Core Qualification: Comp Computational Science and Engineering: Specia | pulsory | | |

| ourse L0180: Theoretical Ele | Lecture |
|------------------------------|--|
| Hrs/wk | |
| CP | |
| | Independent Study Time 108, Study Time in Lecture 42 |
| Lecturer | Prof. Christian Schuster |
| Language | DE |
| Cycle | |
| Content | - 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) |
| | - 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 |
| | The practical application of numerical methods will be trained within specifically prepared lectures in an interactive manner usin small MATLAB programs. |
| Literature | - 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) |
| | - 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 L0181: Theoretical El | rse L0181: Theoretical Electrical Engineering I: Time-Independent Fields | | |
|------------------------------|--|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| CP | 1 | | |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 | | |
| Lecturer | Prof. Christian Schuster | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | |
|--|--|--|-------------------------|---------------------|
| Title | | Тур | Hrs/wk | СР |
| Electrotechnical Experiments (L07) | 4) | Lecture | 1 | 1 |
| Materials in Electrical Engineering | | Lecture | 2 | 3 |
| Materials in Electrical Engineering | Problem Solving Course) (L0687) | Recitation Section (small) | 2 | 2 |
| Module Responsible | Prof. Manfred Eich | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Highschool level physics and mathematics | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students can explain the composition and the structural properties of materials used in electrical engineering. Students c explicate the relevance of mechanical, electrical, thermal, dielectric, magnetic and chemical properties of materials in view of th applications in electrical engineering. | | | |
| Skills | Students can identify appropriate descriptivand judge factors influential on the performation | | | oroximative solutio |
| Personal Competence Social Competence | Students can jointly solve subject related pro problem solving course. | oblems in groups. They can present their res | ults effectively within | the framework of |
| Autonomy | Students are capable to extract relevant info the lecture. They can reflect their acquirec typical exam questions. Students are able to | l level of expertise with the help of lecture | e accompanying mea | |
| Workload in Hours | Independent Study Time 110, Study Time in | Lecture 70 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 60 minutes | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German progra | am, 7 semester): Specialisation Electrical En | gineering: Compulsor | у |
| Following Curricula | Electrical Engineering: Core Qualification: Co | mpulsory | | |
| | General Engineering Science (English progra | m, 7 semester): Specialisation Electrical Eng | ineering: Compulsory | r |
| | Computational Science and Engineering: Spe | ecialisation Engineering Sciences: Elective Co | ompulsory | |
| | Orientierungsstudium: Core Qualification: Ele | ati a Camada a | | |

| Course L0714: Electrotechnic | cal Experiments |
|------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 1 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Wieland Hingst |
| Language | DE |
| Cycle | SoSe |
| 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 |
| | |
| | |

| se L0685: Materials in E | ectrical Engineering |
|--------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 |
| | zo-micipedia, micinealia |

| Course L0687: Materials in E | ilectrical Engineering (Problem Solving Course) |
|------------------------------|--|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| CP | 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) |

| Module M0854: Mathe | ematics IV | | | | |
|---|--|--|-------------------|-----------------------|--|
| Courses | | | | | |
| Courses | | - | | <u></u> | |
| Title Differential Equations 2 (Partial Diff | forential Equations) (11042) | Typ Lecture | Hrs/wk 2 | CP 1 | |
| Differential Equations 2 (Partial Diff | | Recitation Section (small) | 1 | 1 | |
| Differential Equations 2 (Partial Diff | | 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 | None | | | | |
| Recommended Previous | Mathematics 1 - III | | | | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students have reached | the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | Students can name the basic concepts in Math | omatics IV. They are able to explain then | o using appropria | ato oxamplos | |
| | Students can hame the basic concepts in Mati Students can discuss logical connections betw | | | | |
| | the help of examples. | teen these concepts. They are capable | or muscrating th | ese connections with | |
| | They know proof strategies and can reproduce | them | | | |
| | · mey know proor strategies and can reproduce | | | | |
| | | | | | |
| Skills | | | | | |
| SKIIS | Students can model problems in Mathematics | IV with the help of the concepts studie | ed in this course | . Moreover, they are | |
| | capable of solving them by applying establishe | | | | |
| | Students are able to discover and verify further | 5 | | | |
| | For a given problem, the students can devel | op and execute a suitable approach, ar | nd are able to c | itically evaluate the | |
| | results. | | | | |
| | | | | | |
| | | | | | |
| Personal Competence | | | | | |
| Social Competence | Students are able to work together in teams. T | hey are capable to use mathematics as a | a common langua | ade | |
| | In doing so, they can communicate new conce | | | | |
| | design examples to check and deepen the unc | | y p | ,, | |
| | | | | | |
| | | | | | |
| Autonomy | | | | | |
| | Students are capable of checking their underst | standing of complex concepts on their or | wn. They can sp | ecify open questions | |
| | precisely and know where to get help in solvin | | | | |
| | Students have developed sufficient persistent | ce to be able to work for longer periods | s in a goal-orien | ted manner on hard | |
| | problems. | | | | |
| | | | | | |
| | | | | | |
| Workload in Hours | Independent Study Time 68, Study Time in Lecture 1 | 12 | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and | 60 min (Complex Functions) + 60 min (Differential Ed | luations 2) | | | |
| scale | | | | | |
| Assignment for the | General Engineering Science (German program, 7 se | mester): Specialisation Electrical Enginee | ring: Compulsory | / | |
| Following Curricula | General Engineering Science (German program, | 7 semester): Specialisation Mechanica | l Engineering, I | ocus Mechatronics | |
| | Compulsory | | | | |
| | General Engineering Science (German program, 7 se | | | | |
| | General Engineering Science (German program, 7 se | mester): Specialisation Mechanical Engin | eering, Focus Th | eoretical Mechanica | |
| | Engineering: Elective Compulsory | · · · · · · · · | | | |
| | Computer Science: Specialisation Computational Mat | | | | |
| | Computer Science: Specialisation II. Mathematics and | | ry | | |
| | Electrical Engineering: Core Qualification: Compulsor | | | | |
| | Engineering Science: Specialisation Electrical Engine | | ing, Committee | | |
| | General Engineering Science (English program, 7 sen | | | | |
| | General Engineering Science (English program, 7 sen | | | | |
| | General Engineering Science (English program, 5 Compulsory | semester, specialisation Mechanical | Engineering, 1 | JULIA MECHALIONICS | |
| | Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan | | | | |
| | Engineering: Compulsory | nestery, specialisation methallical Englin | comy, rocus III | | |
| | General Engineering Science (English program, 7 sen | nester): Specialisation Naval Architecture | Compulsory | | |
| | Computational Science and Engineering: Specialisation | | | lsorv | |
| | Mechanical Engineering: Specialisation Mechatronics | | | | |
| | Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Elective Compulsory | | | | |
| | Mechanical Engineering: Specialisation Theoretical M | | | | |
| | Mechatronics: Core Qualification: Compulsory | | | | |
| | Naval Architecture: Core Qualification: Compulsory | | | | |
| ł | | | | | |

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 |
| CP | 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 |
| CP | 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 Fund | tions | | | | |
|----------------------------|--|--|--|--|--|
| Тур | Lecture | | | | |
| Hrs/wk | 2 | | | | |
| CP | 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 |
| CP | 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 |

| Courses | | | | | |
|-----------------------------------|---|---|------------------------|---------------------|--|
| Title | | Тур | Hrs/wk | СР | |
| Electrical Machines and Actuators | (L0293) | Lecture | 3 | 4 | |
| Electrical Machines and Actuators | | Recitation Section (large) |) 2 | 2 | |
| Module Responsible | Prof. Thorsten Kern | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Basics of mathematics, in particular comple | exe numbers, integrals, differentials | | | |
| Knowledge | | | | | |
| | Basics of electrical engineering and mechar | nical engineering | | | |
| Educational Objectives | After taking part successfully, students have | e reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | Students can to draw and explain the basic | c principles of electric and magnetic fields. | | | |
| | | | | | |
| | | the standard types of electric machines and present the corresponding equations a | | | |
| | | ves they can explain the major parameters of | the energy emciency | y of the whole syst | |
| | from the power grid to the driven engine. | | | | |
| Skills | Students arw able to calculate two-dimens | sional electric and magnetic fields in particul | ar ferromagnetic circ | uits with air gap. | |
| | this they apply the usual methods of the de | esign auf electric machines. | | | |
| | They can calulate the operational perform | ance of electric machines from their given s | haractoristic data an | d colocted quantit | |
| | | nance of electric machines from their given c usual equivalent circuits and graphical method | | ia selectea quantit | |
| | and characteristic curves. They apply the d | sual equivalent circuits and graphical method | 15. | | |
| | | | | | |
| Personal Competence | | | | | |
| | | | | | |
| Social Competence | | to electric and magnatic fields for application | They are able to a | nalyca indonanda | |
| Autonomy | Students are able independently to calculate electric and magnatic fields for applications. They are able to analyse independent the operational performance of electric machines from the charactersitic data and theycan calculate thereof selected quantiti | | | | |
| | and characteristic curves. | senines norm the characteristic data and the | sycan calculate theree | or selected quantit | |
| | | | | | |
| | | | | | |
| Workload in Hours | Independent Study Time 110, Study Time ir | n Lecture 70 | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Subject theoretical and practical work | | | | |
| Examination duration and | Design of four machines and actuators, revi | iew of design files | | | |
| scale | | | | | |
| Assignment for the | General Engineering Science (German prog | gram, 7 semester): Specialisation Energy and I | Enviromental Enginee | ering: Compulsory | |
| Following Curricula | General Engineering Science (German prog | gram, 7 semester): Specialisation Electrical En | gineering: Elective Co | ompulsory | |
| | General Engineering Science (German prog | ram, 7 semester): Specialisation Mechanical E | Engineering: Elective | Compulsory | |
| | General Engineering Science (German pre- | ogram, 7 semester): Specialisation Mechan | ical Engineering, Foo | cus Energy Syster | |
| | Compulsory | | | | |
| | General Engineering Science (German p | program, 7 semester): Specialisation Mech | anical Engineering, | Focus Mechatron | |
| | Compulsory | | | | |
| | | gram, 7 semester): Specialisation Mechanical | Engineering, Focus Tl | heoretical Mechani | |
| | Engineering: Elective Compulsory | | | | |
| | Digital Mechanical Engineering: Core Qualifi | | | | |
| | Electrical Engineering: Core Qualification: E Energy and Environmental Engineering: Cor | | | | |
| | | ram, 7 semester): Specialisation Electrical Eng | nineering: Elective Co | mpulsory | |
| | | ram, 7 semester): Specialisation Electrical Eng ram, 7 semester): Specialisation Energy and E | | | |
| | | | - | | |
| | General Engineering Science (English progr | am. 7 semester): Specialisation Mechanical E | | | |
| | | ram, 7 semester): Specialisation Mechanical E pecialisation Engineering Sciences: Elective Co | | compulsory | |
| | Computational Science and Engineering: Sp | pecialisation Engineering Sciences: Elective Co | | compulsory | |
| | | pecialisation Engineering Sciences: Elective Co eering Science: Elective Compulsory | | compulsory | |
| | Computational Science and Engineering: Sp Logistics and Mobility: Specialisation Engine | pecialisation Engineering Sciences: Elective Co eering Science: Elective Compulsory : Elective Compulsory | | compuisory | |

| Course L0293: Electrical Mac | hines and Actuators |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Thorsten Kern, Dennis Kähler |
| Language | DE |
| Cycle | SoSe |
| Content | Electric field: Coulomb's law, flux (field) line, work, potential, capacitor, energy, force, capacitive actuators |
| | Magnetic field: force, flux line, Ampere´s law, field at bounderies, flux, magnetic circuit, hysteresis, induction, self-induction, mutual inductance, transformer, electromagnetic actuators |
| | Synchronous machines, construction and layout, equivalent single line diagrams, no-load and short-cuircuit characteristics, vector diagrams, motor and generator operation, stepper motors |
| | 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 (squirrel-cage vs. sliprings), |
| | Drives with variable speed, inverter fed operation, special drives |
| 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 Mac | hines and Actuators |
|------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Thorsten Kern, Dennis Kähler |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Courses | | | | |
|--------------------------|---|--|--------------------|---------------------|
| | | True | Line (sule | CD. |
| Title | nas, and Electromagnetic Compatibility (L1669) | Typ Lecture | Hrs/wk 3 | CP 4 |
| = | nas, and Electromagnetic Compatibility (L1009) | Recitation Section (small) | 2 | 2 |
| | Prof. Christian Schuster | | - | - |
| Admission Requirements | None | | | |
| Recommended Previous | Basic principles of physics and electrical engineering | | | |
| Knowledge | basic principles of physics and electrical engineering | | | |
| 5 | After taking part successfully, students have reached t | he following learning results | | |
| Professional Competence | Arter taking part successiony, students have reached | | | |
| • | Students can evoluin the basis principles, relationshi | as and mothods for the design of wa | voquidos and an | toppos os well os |
| Knowledge | Students can explain the basic principles, relationshi | ps, and methods for the design of wa | veguides and an | tennas as well as |
| | Electromagnetic Compatibility. Specific topics are: | | | |
| | - Fundamental properties and phenomena of electrical | circuits | | |
| | - Steady-state sinusoidal analysis of electrical circuits | | | |
| | - Fundamental properties and phenomena of electrom | agnetic fields and waves | | |
| | - Steady-state sinusoidal description of electromagnet | c fields and waves | | |
| | - Useful microwave network parameters | | | |
| | - Transmission lines and basic results from transmissio | n line theory | | |
| | - Plane wave propagation, superposition, reflection and | l refraction | | |
| | - General theory of waveguides | | | |
| | - Most important types of waveguides and their proper | ties | | |
| | - Radiation and basic antenna parameters | | | |
| | - Most important types of antennas and their propertie | s | | |
| | - Numerical techniques and CAD tools for waveguide a | nd antenna design | | |
| | - Fundamentals of Electromagnetic Compatibility | | | |
| | - Coupling mechanisms and countermeasures | | | |
| | - Shielding, grounding, filtering | | | |
| | - Standards and regulations | | | |
| | - EMC measurement techniques | | | |
| Skills | Students know how to apply various methods and mo | dels for characterization and choice of | waveguides and | antennas. They a |
| | able to assess and qualify their basic electromagn | | | |
| | Electromagnetic Compatibility to the development of e | | 5 | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to work together on subject related | I tasks in small groups. They are able | to present their | results effectively |
| | English (e.g. during small group exercises). | | | |
| Autonomy | Students are capable to gather information from su | bject related professional publication | s and relate tha | t information to t |
| | context of the lecture. They are able to make a conn | | | |
| | other lectures (e.g. theory of electromagnetic fields, f | | | |
| | problems and physical effects in English. | , and a mental of clocklear engineering , | physics). They c | |
| Workload in Hours | |) | | |
| Credit points | | - | | |
| Course achievement | | | | |
| Examination | | | | |
| Examination duration and | 45 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 sem | ester): Specialisation Electrical Enginee | ering: Elective Co | mpulsory |
| | Electrical Engineering: Core Qualification: Elective Con | | | |
| | Aircraft Systems Engineering: Specialisation Air Transp | ortation Systems: Elective Compulsory | | |
| | Aircraft Systems Engineering: Specialisation Cabin Sys | tems: Elective Compulsory | | |
| | General Engineering Science (English program, 7 seme | ester): Specialisation Electrical Engineer | ing: Elective Cor | npulsory |
| | Mechatronics: Specialisation System Design: Elective (| | | |

| Тур | Lecture |
|-------------------|---|
| Hrs/wk | |
| CP | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| | Prof. Christian Schuster |
| Language | DE/EN |
| Cycle | |
| - | This course is intended as an introduction to the topics of wave propagation, guiding, sending, and receiving as well a |
| | Electromagnetic Compatibility (EMC). It will be useful for engineers that face the technical challenge of transmitting high frequence |
| | / high bandwidth data in e.g. medical, automotive, or avionic applications. Both circuit and field concepts of wave propagation |
| | and Electromagnetic Compatibility will be introduced and discussed. |
| | Topics: |
| | - Fundamental properties and phenomena of electrical circuits |
| | - Steady-state sinusoidal analysis of electrical circuits |
| | - Fundamental properties and phenomena of electromagnetic fields and waves |
| | - Steady-state sinusoidal description of electromagnetic fields and waves |
| | - Useful microwave network parameters |
| | - Transmission lines and basic results from transmission line theory |
| | - Plane wave propagation, superposition, reflection and refraction |
| | - General theory of waveguides |
| | - Most important types of waveguides and their properties |
| | - Radiation and basic antenna parameters |
| | - Most important types of antennas and their properties |
| | - Numerical techniques and CAD tools for waveguide and antenna design |
| | - Fundamentals of Electromagnetic Compatibility |
| | - Coupling mechanisms and countermeasures |
| | - Shielding, grounding, filtering |
| | - Standards and regulations - EMC measurement techniques |
| | - EMC measurement techniques |
| | |
| | |
| | |
| | |
| Literature | - Zinke, Brunswig, "Hochfrequenztechnik 1", Springer (1999) |
| | - J. Detlefsen, U. Siart, "Grundlagen der Hochfrequenztechnik", Oldenbourg (2012) |
| | - D. M. Pozar, "Microwave Engineering", Wiley (2011) |
| | - Y. Huang, K. Boyle, "Antenna: From Theory to Practice", Wiley (2008) |
| | - H. Ott, "Electromagnetic Compatibility Engineering", Wiley (2009) |
| | - A. Schwab, W. Kürner, "Elektromagnetische Verträglichkeit", Springer (2007) |

| Course L1877: Introduction t | o Waveguides, Antennas, and Electromagnetic Compatibility |
|------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Christian Schuster |
| Language | DE/EN |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Courses | | | | |
|----------------------------------|--|--|--------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| ntroduction to Communications ar | d Random Processes (L0442) | Lecture | 3 | 4 |
| ntroduction to Communications an | d Random Processes (L0443) | Recitation Section (large) | 1 | 1 |
| ntroduction to Communications ar | d Random Processes (L2354) | Recitation Section (small) | 1 | 1 |
| Module Responsible | Prof. Gerhard Bauch | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mathematics 1-3 | | | |
| Knowledge | Signals and Systems | | | |
| | | | | |
| Educational Objectives | After taking part successfully, students have | e reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students know and understand the fun | damental building blocks of a communications s | ystem. They can o | describe and anal |
| | the individual building blocks using knowled | dge of signal and system theory as well as the t | heory of stochasti | c processes. The |
| | aware of the essential resources and evalu | ation criteria of information transmission and a | e able to design | and evaluate a ba |
| | communications system. | | | |
| Skills | The students are able to design and evaluate a basic communications system. In particular, they can estimate the require | | | |
| | resources in terms of bandwidth and powe | r. They are able to assess essential evaluation p | arameters of a ba | asic communicatio |
| | system such as bandwidth efficiency or bit e | error rate and to decide for a suitable transmission | n method. | |
| Personal Competence | | | | |
| Social Competence | The students can jointly solve specific prob | lems. | | |
| Autonomy | The students are able to acquire relevan | nt information from appropriate literature sou | rces. They can c | ontrol their level |
| | | ing tutorial problems, software tools, clicker syst | - | |
| | | ····g,,,,, | | |
| Workload in Hours | Independent Study Time 110, Study Time in | Lecture 70 | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| | 5 5 7 5 | ram, 7 semester): Specialisation Electrical Engine | ering: Compulsor | у |
| Following Curricula | | and Software Engineering: Elective Compulsory | | |
| | Computer Science: Specialisation Computat | | | |
| | Data Science: Core Qualification: Elective Co | | | |
| | Electrical Engineering: Core Qualification: Co | ompulsory | | |
| | General Engineering Science (English progra | am, 7 semester): Specialisation Electrical Engine | erina: Compulsorv | |
| | centeren Engineering berentee (English progr | | | |
| | Computational Science and Engineering: Co | | | |

| Course L0442: Introduction t | o Communications and Random Processes |
|------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Gerhard Bauch |
| Language | DE/EN |
| Cycle | WiSe |
| 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 |
| Literature | 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 |
| | 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 t | o Communications and Random Processes |
|------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Gerhard Bauch |
| Language | DE/EN |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L2354: Introduction t | o Communications and Random Processes |
|------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Gerhard Bauch |
| Language | DE/EN |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Module M1235: Electr | ical Power Systems I: Introduction | to Electrical Power System | S | |
|--------------------------------------|--|--|---------------------|-------------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| - | tion to Electrical Power Systems (L1670) | Lecture | 3 | 4 |
| Electrical Power Systems I: Introduc | tion to Electrical Power Systems (L1671) | Recitation Section (small) | 2 | 2 |
| Module Responsible | Prof. Christian Becker | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Fundamentals of Electrical Engineering | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reach | ed the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to give an overview of convention | nal and modern electric power systems. | They can explain i | n detail and critically |
| | evaluate technologies of electric power generation, transmission, storage, and distribution as well as integration of equipment in | | | |
| | electric power systems. | | | |
| Skille | With completion of this module the students are able to apply the acquired skills in applications of the design, integratio development of electric power systems and to assess the results. | | | |
| 38///3 | | | | |
| | development of cleatile power systems and to ass | | | |
| Personal Competence | | | | |
| Social Competence | The students can participate in specialized and inte | erdisciplinary discussions, advance ideas | and represent thei | r own work results ir |
| | 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 Lectur | re 70 | | |
| Credit points | 6 | | | |
| Course achievement | | | | |
| Examination | | | | |
| Examination duration and | | | | |
| scale | 50 ISO minutes | | | |
| Assignment for the | General Engineering Science (German program, 7 | semester): Specialisation Electrical Engin | eering: Elective Co | mpulsory |
| Following Curricula | General Engineering Science (German program, 7 General Engineering Science (German program, 7 | | - | |
| y carrieda | Compulsory | | | |
| | Data Science: Core Qualification: Elective Compuls | ory | | |
| | Electrical Engineering: Core Qualification: Elective | • | | |
| | Energy and Environmental Engineering: Specialisat | | sory | |
| | Energy Systems: Specialisation Energy Systems: E | | - | |
| | General Engineering Science (English program, 7 s | | ering: Elective Con | npulsory |
| | Green Technologies: Energy, Water, Climate: Spec | alisation Energy Systems: Elective Comp | ulsory | |
| | Computational Science and Engineering: Specialisa | tion II. Mathematics & Engineering Scien | ce: Elective Compu | lsory |
| | Renewable Energies: Core Qualification: Compulso | ry | | |
| | Theoretical Mechanical Engineering: Specialisation | Energy Systems: Elective Compulsory | | |

| Тур | Lecture |
|-------------------|--|
| Hrs/wk | 3 |
| CP | 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 |
| | • lines |
| | • 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 |
| | • (n-1)-criterion |
| | symmetric failure calculations, short-circuit power |
| | control in networks and power stations |
| | grid protection |
| | grid planning |
| | power economy fundamentals |
| 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 |

| Тур | Recitation Section (small) |
|-------------------|--|
| Hrs/wk | 2 |
| CP | 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 |
| | • lines |
| | • 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 |
| | • (n-1)-criterion |
| | symmetric failure calculations, short-circuit power |
| | control in networks and power stations |
| | grid protection |
| | grid planning |
| | |
| | power economy fundamentals |
| 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 |

| Courses | | | | | |
|---|--|---|---------------------|-----------------------|--|
| Title | | Тур | Hrs/wk | СР | |
| Theoretical Electrical Engineering I | | Lecture | 3 | 5 | |
| Theoretical Electrical Engineering I | | Recitation Section (small) | 2 | 1 | |
| | Prof. Christian Schuster | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Electrical Engineering I, Electrical Engineering II, | Theoretical Electrical Engineering I | | | |
| Knowledge | Mathematics I, Mathematics II, Mathematics III, M | Aathematics IV | | | |
| | | | | | |
| Educational Objectives | After taking part successfully, students have rea | ched the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | Students are able to explain fundamental | | - | | |
| | electromagnetic fields. They can assess the prir | | | | |
| | regard to respective sources. They can describ solutions for simple fields. The students are awa | | | | |
| | able to explicate these. | ine of applications for the theory of time-de | pendent electronia | agrietic fields and a | |
| | | | | | |
| | | | | | |
| Skills | Students are able to apply a variety of procedure | es in order to solve the diffusion and the wa | ave equation for ge | neral time-depende | |
| field problems. They can assess the principal effects of given time-dependent sources of fields and analyze the | | | | | |
| | They can deduce meaningful quantities for the | characterization of fully dynamic fields (| wave impedance, s | skin depth, Poyntin | |
| | vector, radiation resistance, etc.) from given fiel | ds and interpret them with regard to practi | cal applications. | | |
| | | | | | |
| _ | | | | | |
| Personal Competence | | | | | |
| Social Competence | Students are able to work together on subject re during exercise sessions). | elated tasks in small groups. They are able | to present their re | sults effectively (e. | |
| | during exercise sessions). | | | | |
| | | | | | |
| Autonomy | Students are capable to gather necessary inform | nation from provided references and relate | this information to | the lecture. They a | |
| | able to continually reflect their knowledge by means of activities that accompany the lecture, such as short oral quizzes during the | | | | |
| | lectures and exercises that are related to the ex | am. Based on respective feedback, studen | s are expected to a | adjust their individu | |
| | learning process. They are able to draw con | nections between acquired knowledge a | nd ongoing resea | rch at the Hambu | |
| | University of Technology (TUHH), e.g. in the area | a of high frequency engineering and optics. | | | |
| | | | | | |
| Mauldeed in H | Independent Chudy Time 110, Chudy Time 1, 1 | hung 70 | | | |
| Workload in Hours Credit points | Independent Study Time 110, Study Time in Lecture 70 | | | | |
| Course achievement | None | | | | |
| | Written exam | | | | |
| Examination duration and | | | | | |
| scale | | | | | |
| Assignment for the | General Engineering Science (German program, | 7 semester): Specialisation Electrical Engir | eering: Compulsor | у | |
| Following Curricula | Electrical Engineering: Core Qualification: Comp | ulsory | | | |
| | Technomathematics: Specialisation III. Engineeri | ng Science: Elective Compulsory | | | |

| Course L0182: Theoretical El | ectrical Engineering II: Time-Dependent Fields |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 5 |
| Workload in Hours | Independent Study Time 108, Study Time in Lecture 42 |
| Lecturer | Prof. Christian Schuster |
| Language | |
| Cycle | |
| Content | - 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 |
| | - 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 |
| | The practical application of numerical methods will be trained within specifically prepared lectures in an interactive manner using small MATLAB programs. |
| Literature | - 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) |
| | - 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 El | ourse 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 | | |
| Lecturer | Prof. Christian Schuster | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Module M0783: Meas | urements: Metl | nods and Da | ta Processing | | | |
|--------------------------------|-------------------------|--------------------|----------------------------|------------------------------|-----------------------|----------------------|
| Courses | | | | | | |
| Title | | | | Тур | Hrs/wk | СР |
| EE Experimental Lab (L0781) | | | | Practical Course | 2 | 2 |
| Measurements: Methods and Data | Processing (L0779) | | | Lecture | 2 | 3 |
| Measurements: Methods and Data | Processing (L0780) | | | Recitation Section (small) | 1 | 1 |
| Module Responsible | Prof. Alexander Schla | efer | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | principles of mathem | atics | | | | |
| Knowledge | principles of electrica | l engineering | | | | |
| Educational Objectives | After taking part succ | essfully, students | have reached the following | ng learning results | | |
| Professional Competence | | | | | | |
| Knowledge | The students are able | e to explain the p | urpose of metrology and | the acquisition and proce | essing of measureme | ents. They can deta |
| | aspects of probability | theory and errors | s, and explain the process | ing of stochastic signals. | Students know meth | ods to digitalize an |
| | describe measured si | gnals. | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Skills | The students are able | to evaluate prob | lems of metrology and to | apply methods for describ | oing and processing | of measurements. |
| | | | | | | |
| | | | | | | |
| Personal Competence | | | | | | |
| Social Competence | The students solve pr | oblems in small g | roups. | | | |
| Autonomy | The students can refl | act their knowledg | ge and discuss and evalua | to their results | | |
| Autonomy | The students carrier | eet their knowledg | | te then results. | | |
| | | | | | | |
| Workload in Hours | Independent Study Ti | me 110, Study Tir | me in Lecture 70 | | | |
| Credit points | | | | | | |
| Course achievement | | Form | Description | | | |
| | Yes 10 % | Excercises | | | | |
| Examination | Written exam | | | | | |
| Examination duration and | 90 min | | | | | |
| scale | | | | | | |
| Assignment for the | General Engineering | Science (German | program, 7 semester): Spe | ecialisation Electrical Engi | ineering: Elective Co | mpulsory |
| Following Curricula | | | | | | |
| | | | rogram, 7 semester): Spe | cialisation Electrical Engin | neerina: Elective Cor | npulsorv |
| | | | Engineering Science: Elec | - | | |
| | | | Defender Liee | | | |

| Course L0781: EE Experimen | tal 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. Rolf-Rainer Grigat, Prof. Herbert Werner, Dozenten des SD E, Prof. Christian Becker, Prof. Heiko |
| | Falk, Prof. Thorsten Kern, Prof. Alexander Kölpin |
| 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: Measurement | s: Methods and Data Processing |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Alexander Schlaefer |
| Language | DE |
| Cycle | WiSe |
| Content | 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: Measurement | ourse L0780: Measurements: Methods and Data Processing | |
|---------------------------|--|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| CP | 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 | |

Module Manual B.Sc. "General Engineering Science (German program, 7 semester)"

| Module M0760: Elect | ronic Devices | | | | |
|---|--|-------------------------------|---|----------------|----------------------|
| Courses | | | | | |
| Title | | | Тур | Hrs/wk | СР |
| Electronic Devices (L0720) | | | Lecture | 3 | 4 |
| Electronic Devices (L0721) | | | Project-/problem-based Learning | 2 | 2 |
| Module Responsible | Prof. Hoc Khiem Trieu | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Atomic model and quantum theory, electric | ical currents in solid sta | ate materials, basics in solid-sta | te physics | |
| Knowledge | Successful participation of Physics for Eng | ineers and Materials in | Electrical Engineering or course | s with equival | ent contents |
| Educational Objectives | After taking part successfully, students ha | ve reached the following | ng learning results | | |
| Professional Competence | | | | | |
| Knowledge | | | | | |
| | Students are able | | | | |
| | | lunder a la sel na | | | |
| | to represent the basics of semicond | luctor physics, | | | |
| | to explain the operating principle of | important semicondu | ctor devices, | | |
| | to outline device characteristics and | d equivalent circuits as | well as to explain their derivation | on and | |
| | the discussion by the limit bing of devices of | | | | |
| | to discuss the limitation of device m | lodels. | | | |
| | | | | | |
| Skills | | | | | |
| | | | | | |
| | Students are capable | | | | |
| | to apply devices in basic circuits, | | | | |
| | to realize the physical context and to solve complex problems by oneself | | | | |
| | | | | | |
| Personal Competence | | | | | |
| | Students are able to prepare and perform | their lab experiments | in team work as well as to pres | ent and discus | s the results in fro |
| | of audience. | | | | |
| 4 | Churchen berner ander bler berner viere bereide der | | | | |
| Autonomy Workload in Hours | Students are capable to acquire knowledg Independent Study Time 110, Study Time | | Torder to prepare their experim | ents. | |
| Credit points | 6 | In Lecture 70 | | | |
| Course achievement | Compulsory Bonus Form | Description | | | |
| | Yes 10 % Subject theoretic practical work | demonstriere Diskussion. [| erarbeiten in Kleingruppen Wis en dieses in Form eines Vo Darüber hinaus betreut jede (| ersuches mit | Präsentation u |
| Evamination | Writton oxam | inhaltlich zu d | dem jeweiligen Versuch gehört. | | |
| Examination Examination duration and | Written exam | | | | |
| scale | 120 1111 | | | | |
| Assignment for the | General Engineering Science (German pro | gram, 7 semester): Sp | ecialisation Electrical Engineerin | g: Compulsory | , |
| Following Curricula | Electrical Engineering: Core Qualification: | | - | . , | |
| | Engineering Science: Specialisation Electri | cal Engineering: Comp | oulsory | | |
| | General Engineering Science (English prog | | 5 5 | , , , | |
| | Computational Science and Engineering: S | pecialisation II. Mathe | matics & Engineering Science: E | lective Compu | lsory |

| Course L0720: Electronic Dev | vices |
|------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 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 Dev | ourse L0721: Electronic Devices | |
|------------------------------|---|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 2 | |
| CP | 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 | |

| Courses | | | | |
|--|--|--|--|-----------------|
| Title | | Тур | Hrs/wk | СР |
| Semiconductor Circuit Design (L076 | 3) | Lecture | 3 | 4 |
| Semiconductor Circuit Design (L086 | 54) | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Matthias Kuhl | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Fundamentals of electrical engineering | | | |
| Knowledge | Basics of physics, especially semiconducto | r physics | | |
| Educational Objectives | After taking part successfully, students have | ve reached the following learning results | | |
| Professional Competence Knowledge | Students are able to explain how an Students are able to explain the function Students know the fundamental digitation | ctionality of different MOS devices in electroni alog circuits functions and where they are app ctionality of fundamental operational amplifier ital logic circuits and can discuss their advanta mory circuits and can explain their functionali s for the use of bipolar transistors. | lied. rs and their specification ages and disadvantage | |
| 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 logic circuits. Students can use MOS devices, operational amplifiers and bipolar transistors for specific applications. | | | |
| Personal Competence Social Competence | Students are able work efficiently in Students working together in small g | heterogeneous teams. groups can solve problems and answer profess | sional questions. | |
| Autonomy | • Students are able to assess their lev | vel of knowledge. | | |
| Workload in Hours | Independent Study Time 124, Study Time i | in Lecture 56 | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | | | | |
| Examination duration and | | | | |
| scale | 120 mm | | | |
| Assignment for the | General Engineering Science (German proc | gram, 7 semester): Specialisation Electrical En | aineerina: Compulsory | / |
| - | | program, 7 semester): Specialisation Mech | | |
| | Compulsory | | | |
| | Data Science: Core Qualification: Elective C | Compulsory | | |
| | Electrical Engineering: Core Qualification: C | Compulsory | | |
| | Engineering Science: Specialisation Electric | cal Engineering: Compulsory | | |
| | Engineering Science: Specialisation Mecha | tronics: Compulsory | | |
| | General Engineering Science (English prog | ram, 7 semester): Specialisation Electrical Eng | ineering: Compulsory | |
| | | program, 7 semester): Specialisation Mech | anical Engineering, F | ocus Mechatroni |
| | Compulsory | | | |
| | 5 5 7 5 7 5 | ram, 7 semester): Specialisation Mechatronics | | la su c |
| | | pecialisation II. Mathematics & Engineering Sc | ience: Elective Compu | isory |
| | Mechanical Engineering: Specialisation Mec | | | |
| | Mechatronics: Core Qualification: Compulse | or y | | |

| urse L0763: Semiconducto | |
|--------------------------|--|
| Тур | Lecture |
| Hrs/wk | |
| СР | |
| | Independent Study Time 78, Study Time in Lecture 42 |
| | Prof. Matthias Kuhl |
| Language | |
| Cycle | SoSe |
| Content | Repetition Semiconductorphysics and Diodes Functionality and characteristic curve of bipolar transistors Basic circuits with bipolar transistors Functionality and characteristic curve of MOS transistors Basic circuits with MOS transistors for amplifiers Operational amplifiers and their applications Typical applications for analog and digital circuits Realization of logical functions Basic circuits with MOS transistors for combinational logic Memory circuits Basic circuits with MOS transistors for sequential logic Basic concepts of analog-to-digital and digital-to-analog-converters |
| Literature | U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 0471700555 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: Semiconducto | or Circuit Design |
|----------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| CP | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Matthias Kuhl, Weitere Mitarbeiter |
| Language | DE |
| Cycle | SoSe |
| Content | Basic circuits and characteristic curves of bipolar transistors Basic circuits and characteristic curves of MOS transistors for amplifiers Realization and dimensioning of operational amplifiers Realization of logic functions Basic circuits with MOS transistors for combinational and sequential logic Memory circuits Circuits for analog-to-digital and digital-to-analog converters Design of exemplary circuits |
| Literature | U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 0471700555 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 |

| ^ | | | | | |
|--------------------------------------|---|--|-----------------|------------------------|--|
| Courses | | | | | |
| Fitle | aton (10640) | Typ | Hrs/wk | CP | |
| Electrical Engineering Project Labor | - | Project-/problem-based Learning | 8 | 6 | |
| Module Responsible | | | | | |
| Admission Requirements | | - 11 | | | |
| | Electrical Engineering I, Electrical Engineering |] [] | | | |
| Knowledge | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning results | | | |
| Professional Competence | Arter taking part successivily, students have | reaction are following reacting results | | | |
| - | Students are able to give a summary of th | ne technical details of projects in the area of ele | ectrical engine | eering and illustrat | |
| | | f describing and communicating relevant problems | | | |
| | | cal process of solving practical problems and prese | | | |
| | | | | | |
| | | | | | |
| Skills | The students can transfer their fundamenta | I knowledge on electrical engineering to the proc | ess 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 concep | btual solutions for non-standardized problems. | | | |
| | | | | | |
| | | | | | |
| Personal Competence | | | | | |
| Social Competence | • | ed-subject groups in order to independently derive able to effectively present and explain their result | - | | |
| | | bility to develop alternative approaches to an | | | |
| | independently or in groups and discuss advar | | cicculcul c | ingineering probler | |
| | ······································ | | | | |
| | | | | | |
| Autonomy | Students are capable of independently solvin | g electrical engineering problems using provided li | terature. They | / are able to fill gap | |
| | in as well as extent their knowledge using t | the literature and other sources provided by the s | supervisor. Fu | rthermore, they car | |
| | meaningfully extend given problems and prag | gmatically solve them by means of corresponding s | olutions and c | oncepts. | |
| | | | | | |
| | | | | | |
| | Independent Study Time 68, Study Time in Le | ecture 112 | | | |
| Credit points | 6 | | | | |
| Course achievement | | | | | |
| | Subject theoretical and practical work | | | | |
| | based on task + presentation | | | | |
| scale | | | | | |
| - | | m, 7 semester): Specialisation Electrical Engineerin | g: Compulsory | / | |
| Following Curricula | Electrical Engineering: Core Qualification: Cor | | | | |
| | Engineering Science: Specialisation Electrical | Engineering: Compulsory n, 7 semester): Specialisation Electrical Engineering | r Compulsory | | |
| | Technomathematics: Specialisation III. Engine | | . compuisory | | |

| Course L0640: Electrical Eng | ineering Project Laboratory |
|------------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 8 |
| CP | 6 |
| Workload in Hours | Independent Study Time 68, Study Time in Lecture 112 |
| 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 Enviromental 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 CO_2 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 CO_2 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.

| ourses | | | | | | |
|-----------------------------|--|---------------------------------|---|---------------------|-------------------|--|
| itle | | | Тур | Hrs/wk | СР | |
| omputer Engineering (L0321) | | | Lecture | 3 | 4 | |
| omputer Engineering (L0324) | | | Recitation Section (small) | 1 | 2 | |
| Module Responsible | Prof. Heiko Falk | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Basic knowledge in ele | ctrical engineering | | | | |
| Knowledge | | | | | | |
| Educational Objectives | After taking part succe | ssfully, students have reache | d the following learning results | | | |
| Professional Competence | | | | | | |
| Knowledge | | | tionality of computing systems. It cov | ers the layers from | n the assembly-le | |
| | programming down to | gates. The module includes th | ne following topics: | | | |
| | Introduction | | | | | |
| | Combinational lo | ogic: Gates, Boolean algebra, | Boolean functions, hardware synthesis, | combinational net | works | |
| | | : Flip-flops, automata, system | atic hardware design | | | |
| | Technological for | | | | | |
| | Computer arithmetic: Integer addition, subtraction, multiplication and division | | | | | |
| | | - | g models, MIPS single-cycle architecture | e, pipelining | | |
| | | ory hierarchies, SRAM, DRAM, | cacnes CPU, principles of passing data, point-to | point connections | hussos | |
| | | findin the perspective of the t | cro, principles of passing data, point-to | -point connections | , busses | |
| | | | | | | |
| Skills | s The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the | | | | | |
| | | | analyze, how highly specific and indivi | | | |
| | collection of few and simple components. They are able to distinguish between and to explain the different abstract today's computing systems - from gates and circuits up to complete processors. | | | | | |
| | today s computing syst | terns - noni gates and circuits | up to complete processors. | | | |
| | After successful comp | letion of the module, the stu | dents are able to judge the interdepe | ndencies between | a physical compu | |
| | - | | ar, they shall understand the conseque | | | |
| | 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 I | ow abstraction levels have on | an entire system's performance and to | propose feasible | options. | |
| Personal Competence | | | | | | |
| Social Competence | Students are able to so | olve similar problems alone or | in a group and to present the results a | ccordingly. | | |
| | | | | | | |
| Autonomy | Students are able to ac | cquire new knowledge from sp | ecific literature and to associate this ki | nowledge with othe | er classes. | |
| Workload in Hours | Independent Study Tim | ne 124, Study Time in Lecture | 56 | | | |
| Credit points | 6 | | | | | |
| Course achievement | Compulsory Bonus | Form D | escription | | | |
| | Yes 10 % | Excercises | | | | |
| Examination | Written exam | | | | | |
| Examination duration and | 90 minutes, contents o | f course and labs | | | | |
| scale | | | | | | |
| - | | | mester): Specialisation Computer Scien | | | |
| Following Curricula | | | mester): Specialisation Bioprocess Eng | e . | ory | |
| | General Engineering Science (German program, 7 semester): Specialisation Naval Architecture: Compulsory General Engineering Science (German program, 7 semester): Specialisation Electrical Engineering: Compulsory | | | | | |
| | General Engineering So General Engineering So | 1 5 | mester): Specialisation Electrical Engin | eering: compulsor | у | |

Module Manual B.Sc. "General Engineering Science (German program, 7 semester)"

| 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 |
| General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: |
| Compulsory |
| General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory |
| Computer Science: Core Qualification: Compulsory |
| Data Science: Core Qualification: Elective Compulsory |
| Electrical Engineering: Core Qualification: Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Civil 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 Computer Science: 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 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 Naval Architecture: Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Noval Architecture: Compulsory General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory |
| Computational Science and Engineering: Core Qualification: Compulsory |
| Mechatronics: Core Qualification: Compulsory |
| Technomathematics: Specialisation II. Informatics: Elective Compulsory |
| recimonitation de specialisation n. montales. Elective compaisory |

| Course L0321: Computer Eng | gineering | | | | |
|----------------------------|---|--|--|--|--|
| Тур | Lecture | | | | |
| Hrs/wk | 3 | | | | |
| CP | | | | | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | | | | |
| Lecturer | Prof. Heiko Falk | | | | |
| Language | DE/EN | | | | |
| 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. | | | | |

Module Manual B.Sc. "General Engineering Science (German program, 7 semester)"

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

| Courses | | | | |
|------------------------------------|---|---|--|---------------------------------------|
| Title | Тур | Hrs/wk | СР | |
| Fundamentals of Materials Science | II (Advanced Ceramic Materials, Polymers and Composites) (L0506) | Lecture Lecture | 2 | 2 2 |
| Physical and Chemical Basics of Ma | | Lecture | 2 | 2 |
| Module Responsible | | | | _ |
| Admission Requirements | | | | |
| | Highschool-level physics, chemistry und mathematics | | | |
| Knowledge | nighschool-level physics, chemistry und mathematics | | | |
| Educational Objectives | After taking part successfully, students have reached the follow | ving learning results | | |
| Professional Competence | | | | |
| Knowleage | The students have acquired a fundamental knowledge on r comprehensively. Fundamental knowledge here means specific phase transformations, corrosion and mechanical properties. Th for materials and can identify relevant approaches for cha phenomena back to the underlying physical and chemical laws | ally the issues of atom ne students know abou aracterizing specific pr | nic structure, microstructu ut the key aspects of chara | re, phase diagra acterization meth |
| Skills | The students are able to trace materials phenomena back to phenomena here refers to mechanical properties such as stree resistance, and to phase transformations such as solidificatio between processing conditions and the materials microstructure material's behavior. | ngth, ductility, and stir n, precipitation, or m | ffness, chemical propertie elting. The students can | s such as corros explain the rela |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | - | | | |
| | Independent Study Time 96, Study Time in Lecture 84 | | | |
| Credit points | | | | |
| Course achievement | | | | |
| | | | | |
| | Written exam | | | |
| Examination duration and | 180 min | | | |
| scale | | | | |
| - | General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S | | | - |
| Following Curricula | General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S | | | - |
| | General Engineering Science (German program, 7 semester): S | | | ng. compuisory |
| | General Engineering Science (German program, 7 semester). S | | | |
| | General Engineering Science (German program, 7 semester): S | | incecture. compulsory | |
| | General Engineering Science (German program, 7 semester): S | | | |
| | Data Science: Specialisation Materials Science: Compulsory | • | | |
| | Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory | | | |
| | Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Com | npulsory | d Enviromental Engineerir | na: Compulsory |
| | Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Con General Engineering Science (English program, 7 semester): Sp | npulsory pecialisation Energy an | - | |
| | Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Con General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp | pulsory pecialisation Energy an pecialisation Mechanica | al Engineering: Compulsor | |
| | Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Con General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp | polisory pecialisation Energy an pecialisation Mechanica pecialisation Naval Arch | al Engineering: Compulsor hitecture: Compulsory | y |
| | Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Con General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp | npulsory necialisation Energy an necialisation Mechanica necialisation Naval Arch necialisation Biomedica | al Engineering: Compulsor hitecture: Compulsory al Engineering: Compulsory | y |
| | Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Com General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp | npulsory necialisation Energy an necialisation Mechanica necialisation Naval Arch necialisation Biomedica necialisation Naval Arch | al Engineering: Compulsor hitecture: Compulsory al Engineering: Compulsory | y |
| | Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Com General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp Logistics and Mobility: Specialisation Engineering Science: Elect | npulsory necialisation Energy an necialisation Mechanica necialisation Naval Arch necialisation Biomedica necialisation Naval Arch | al Engineering: Compulsor hitecture: Compulsory al Engineering: Compulsory | y |
| | Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Com General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp Logistics and Mobility: Specialisation Engineering Science: Elect Mechanical Engineering: Core Qualification: Compulsory | npulsory necialisation Energy an necialisation Mechanica necialisation Naval Arch necialisation Biomedica necialisation Naval Arch | al Engineering: Compulsor hitecture: Compulsory al Engineering: Compulsory | y |
| | Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Com General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp Logistics and Mobility: Specialisation Engineering Science: Elect | npulsory necialisation Energy an necialisation Mechanica necialisation Naval Arch necialisation Biomedica necialisation Naval Arch | al Engineering: Compulsor hitecture: Compulsory al Engineering: Compulsory | y |

| Course L1085: Fundamentals | s of Materials Science I |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 P. Haasen: Physikalische Metallkunde. Springer 1994 |

| Course L0506: Fundamentals | of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) | | | | |
|----------------------------|--|--|--|--|--|
| Тур | Lecture | | | | |
| Hrs/wk | 2 | | | | |
| CP | 2 | | | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | | | |
| Lecturer | Prof. Bodo Fiedler, Prof. Gerold Schneider | | | | |
| Language | | | | | |
| Cycle | SoSe | | | | |
| Content | hemische 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 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Stefan Fritz 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 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 | | | | Tun | Hee /under | СР | |
| Embodiment Design and 3D-CAD (I | 0268) | | | Typ Lecture | Hrs/wk 2 | 1 | |
| Mechanical Design Project I (L0695) | | | | Project-/problem-based Learning | 2 | 2 | |
| Mechanical Design Project II (L0592) | | | | Project-/problem-based Learning | 3 | 2 | |
| Team Project Design Methodology (L0267) | | | | Project-/problem-based Learning | 2 | 1 | |
| Module Responsible | Prof. Dieter Krause | | | | | | |
| Admission Requirements | None | | | | | | |
| Recommended Previous | | | | | | | |
| Knowledge | Fundamentals of Mechanical Engineering Design | | | | | | |
| | Mechanics | f Matariala Caisara | | | | | |
| | | s of Materials Science | | | | | |
| | Production Er | igineering | | | | | |
| Educational Objectives | After taking part suc | ccessfully, students have re | ached the following | g learning results | | | |
| Professional Competence | | | | | | | |
| Knowledge | After passing the me | odule, students are able to: | | | | | |
| | explain desig | n quidelines for machinery | narts e a consider | ing load situation, materials an | d manufactur | ing requirements | |
| | describe basi | | parts e.g. consider | ing load situation, materials and | | ing requirements | |
| | | s methods of engineering d | esianina. | | | | |
| | | | | | | | |
| Skills | After passing the me | odule, students are able to: | | | | | |
| | independentl | y create sketches, technica | I drawings and doc | cumentations e.g. using 3D CAD |), | | |
| | design compo | onents based on design gui | delines autonomou | isly, | | | |
| | dimension (ca | alculate) used components, | | | | | |
| | use methods | to design and solve engine | ering design tasks | systamtically and solution-orier | nted, | | |
| | apply creativity | ty techniques in teams. | | | | | |
| Personal Competence | | | | | | | |
| | After passing the m | odule, students are able to: | | | | | |
| Social competence | Arter passing the m | | | | | | |
| | 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 ow | n results in the work group | s of the course. | | | | |
| Autonomy | Students are able | | | | | | |
| | | h a tha barrach a ff bar a such a dar a such | | a ala suddhina dha la absona (a as sui | | | |
| | | neir level of knowledge usi neering design tasks syster | | nods within the lectures (e.g. wi | ith clickers), | | |
| | To solve engli | neering design tasks syster | natically. | | | | |
| Workload in Hours | Independent Study | Time 40, Study Time in Lec | ture 140 | | | | |
| Credit points | | | | | | | |
| Course achievement | Compulsory Bonus Yes None | Form Written elaboration | Description | Construktionsmethodik | | | |
| | Yes None | Written elaboration | Konstruktions | | | | |
| | Yes None | Written elaboration | Konstruktions | | | | |
| | Yes None | Written elaboration | 3D-CAD-Prakti | , | | | |
| Examination | Written exam | | 0.10 11000 | | | | |
| Examination duration and | | | | | | | |
| scale | | | | | | | |
| | General Engineering | Science (German program | , 7 semester): Spe | cialisation Mechanical Engineer | ing: Compuls | ory | |
| Following Curricula | General Engineering | Science (German program | , 7 semester): Spe | cialisation Biomedical Engineer | ing: Compuls | ory | |
| - | General Engineering Science (German program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory | | | | | | |
| | Digital Mechanical E | ngineering: Core Qualificat | ion: Compulsory | | - | | |
| | Energy and Environ | mental Engineering: Core Q | ualification: Comp | ulsory | | | |
| | General Engineering Science (English program, 7 semester): Specialisation Energy and Environmental Engineering: Compulsory | | | | | | |
| General Engineering Science (English program, 7 semester): Specialisation Mechanical Engin | | | | | | ory | |
| | General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory | | | | | | |
| | Mechanical Enginee | ring: Core Qualification: Co | mpulsory | | | | |
| | Mechatronics: Core | Qualification: Compulsory | | | | | |
| | Naval Architecture: | Core Qualification: Compute | | | | | |

| Course L0268: Embodiment I | Design and 3D-CAD |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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. Maschinenelemente, Band I-III; Niemann, G., Springer-Verlag, aktuelle Auflage. Konstruktionslehre, Pahl, G.; Beitz, W., 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 De | esign 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 D | Course L0592: Mechanical Design Project II | | |
|----------------------------|---|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 3 | | |
| CP | 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. | | |

| ourse L0267: Team Project | Design Methodology |
|---------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 2 |
| CP | 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 | | | | |
|--|--|---|---|----------------------|
| Title Fundamentals of Fluid Mechanics (L | | Typ Lecture | Hrs/wk | CP 4 |
| Fluid Mechanics for Process Engine | | Recitation Section (large) | 2 | 2 |
| Module Responsible | | | | |
| Admission Requirements Recommended Previous | None | | | |
| Knowledge | Mathematics I+II+III Technical Mechanics I+II Technical Thermodynamics I+II Working with force balances Simplification and solving of partial dif Integration | fferential equations | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning results | | |
| Professional Competence Knowledge | Students are able to: • explain the difference between differe • give an overview for different applicat | | rocess engineering | |
| Skills | 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 condition Skills | | ions | |
| | notice the dependency between theor | d mechanics by simplifications to archive qu | | e.g. by integration |
| Personal Competence | | | | |
| <i>Social Competence</i> <i>Autonomy</i> | are capable to gather information from of the lecture and able to work together on subject relative (e.g. during small group exercises) are able to work out solutions for exert The students are able to search further literature for each topic | m subject related, professional publications a ted tasks in small groups. They are able to cises by themselves, to discuss the solutions : and to expand their knowledge with this lite nd to evaluate their actual knowledge with th | oresent their results orally and to preser rature, | effectively in Engli |
| Workload in Hours | Independent Study Time 124, Study Time in | Lecture 56 | | |
| Credit points | | | | |
| Course achievement | | Description | | |
| French atten | Yes 5 % Midterm | | | |
| Examination Examination duration and | | | | |
| scale | 5 10015 | | | |
| | General Engineering Science (German progra | am. 7 semester): Specialisation Process Engi | neering: Compulsory | |
| Following Curricula | General Engineering Science (German progra General Engineering Science (German progra General Engineering Science (German progra Bioprocess Engineering: Core Qualification: C Energy and Environmental Engineering: Core General Engineering Science (English progra General Engineering Science (English progra General Engineering Science (English progra | am, 7 semester): Specialisation Energy and E am, 7 semester): Specialisation Green Techn Compulsory e Qualification: Compulsory m, 7 semester): Specialisation Bioprocess En m, 7 semester): Specialisation Energy and En | nviromental Enginee ologies: Compulsory gineering: Compulso nviromental Engineer | ering: Compulsory |

| Course L0091: Fundamentals | s of Fluid Mechanics |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. Michael Schlüter |
| Language | DE |
| Cycle | SoSe |
| 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. München, Pearson Studium, 2007 Oertl, H.: 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 |

| Course L0092: Fluid Mechani | ics for Process Engineering |
|-----------------------------|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| CP | 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. 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 | | Typ | Hrs/wk | СР |
| Electrical Machines and Actuators (| L0293) | Typ Lecture | 3 | 4 |
| Electrical Machines and Actuators (| | Recitation Section (large) | 2 | 2 |
| Module Responsible | Prof. Thorsten Kern | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basics of mathematics, in particular com | plexe numbers, integrals, differentials | | |
| Knowledge | | | | |
| | Basics of electrical engineering and mech | nanıcal engineering | | |
| Educational Objectives | After taking part successfully, students h | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students can to draw and explain the ba | sic principles of electric and magnetic fields. | | |
| | These are described that four this is a full | | | |
| | | e standard types of electric machines and pre | | |
| | from the power grid to the driven engine. | drives they can explain the major parameters of th | le energy eniciency | of the whole syst |
| | nom the power gha to the unven engine. | | | |
| Skills | Students arw able to calculate two-dime | ensional electric and magnetic fields in particular | ferromagnetic circ | uits with air gap. |
| | this they apply the usual methods of the | design auf electric machines. | | |
| | They can calulate the operational perfor | mance of electric machines from their given cha | racteristic data an | d selected quantit |
| | | e usual equivalent circuits and graphical methods. | racteristic data an | a sereccea quarra |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | none | | | |
| | | late electric and magnatic fields for applications. | They are able to a | nalvse independer |
| | | machines from the charactersitic data and theyc | | |
| | and characteristic curves. | | | |
| | | | | |
| | | | | |
| Workload in Hours | Independent Study Time 110, Study Time | e in Lecture 70 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Subject theoretical and practical work | | | |
| Examination duration and | Design of four machines and actuators, r | eview of design files | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German pr | ogram, 7 semester): Specialisation Energy and En | viromental Enginee | ering: Compulsory |
| Following Curricula | General Engineering Science (German pr | ogram, 7 semester): Specialisation Electrical Engir | neering: Elective Co | ompulsory |
| | | ogram, 7 semester): Specialisation Mechanical Eng | | |
| | | program, 7 semester): Specialisation Mechanica | I Engineering, Foo | cus Energy Syster |
| | Compulsory | - | | |
| | | program, 7 semester): Specialisation Mechan | ical Engineering, | Focus Mechatroni |
| | Compulsory | agram 7 competer), Specialization Machanical En | aincoring Focus Th | hooratical Machani |
| | Engineering: Elective Compulsory | ogram, 7 semester): Specialisation Mechanical En | gineering, rocus ri | |
| | Digital Mechanical Engineering: Core Qua | alification: Compulsory | | |
| | Electrical Engineering: Core Qualification | | | |
| | Energy and Environmental Engineering: (| | | |
| | 5, 5 5 | gram, 7 semester): Specialisation Electrical Engin | eering: Elective Cor | mpulsory |
| | | gram, 7 semester): Specialisation Energy and Env | - | |
| | General Engineering Science (English pro | ogram, 7 semester): Specialisation Mechanical Eng | ineering: Elective C | Compulsory |
| | Computational Science and Engineering: | Specialisation Engineering Sciences: Elective Com | pulsory | |
| | Logistics and Mobility: Specialisation Eng | ineering Science: Elective Compulsory | | |
| | Mechanical Engineering: Core Qualification | on: Elective Compulsory | | |
| | Mechatronics: Core Qualification: Compu | lsorv | | |
| | | | | |

| Course L0293: Electrical Mac | hines and Actuators |
|------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Thorsten Kern, Dennis Kähler |
| Language | DE |
| Cycle | SoSe |
| Content | Electric field: Coulomb's law, flux (field) line, work, potential, capacitor, energy, force, capacitive actuators |
| | Magnetic field: force, flux line, Ampere´s law, field at bounderies, flux, magnetic circuit, hysteresis, induction, self-induction, mutual inductance, transformer, electromagnetic actuators |
| | Synchronous machines, construction and layout, equivalent single line diagrams, no-load and short-cuircuit characteristics, vector diagrams, motor and generator operation, stepper motors |
| | 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 (squirrel-cage vs. sliprings), |
| | Drives with variable speed, inverter fed operation, special drives |
| 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 Mac | Course L0294: Electrical Machines and Actuators | |
|------------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Thorsten Kern, Dennis Kähler | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|----------------------------------|---|--|--|--------------------------------------|
| Title | | Тур | Hrs/wk | СР |
| Power Industry (L0316) | | Lecture | 1 | 1 |
| Energy Systems and Energy Indust | ry (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 | none | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students ha | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | efficiency. They can explain the issues oc distribution and power trading wih reg applicable to many energy systems in g | dents can provide an overview of characteristics curring in this context. Furthermore, they can ex lard to subject-related contexts. The students eneral, especially for renewable energy systems tal benefits from the use of such systems. | plain details of powe can explain these | er generation, pov aspects, which |
| Skills | ///s Students are able to apply methodologies for detailed determination of energy demand or energy production for various energy systems. Furthermore, they can evaluate energy systems technically, environmentally and economically and des under certain given conditions. Therefore, they can choose the necessary subject-specific calculation rules, also standardized solutions of a problem. The students are able to explain questions and possible approaches to its processing from the field of renewable energy | | ally and design th rules, also for | |
| Devenuel Commentence | and to put them them into the right conte | ext. | | |
| Personal Competence | The shudents are able to each as a witch | In the share of the second terms and the second terms with second s | | |
| Social Competence | | le technical alternatives and to assess them wi allows them to make an effective contribuition to | | |
| Autonomy | Students can independently exploit sour | rces , acquire the particular knowledge about th | e subject area and | l transform it to i |
| , | questions. | | | |
| | | | | |
| Workload in Hours | Independent Study Time 96, Study Time i | in Lecture 84 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 3 hours written exam | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German pro | ogram, 7 semester): Specialisation Energy and En | viromental Enginee | ring: Compulsory |
| Following Curricula | General Engineering Science (German pro | ogram, 7 semester): Specialisation Process Engine | eering: Compulsory | |
| | General Engineering Science (German | program, 7 semester): Specialisation Mechanic | al Engineering, Foc | us Energy Syste |
| | Elective Compulsory | | | |
| | General Engineering Science (German) | program, 7 semester): Specialisation Mechanic | al Engineering, Foc | us Energy Syste |
| | Compulsory | • • • • • • | | |
| | | ecialisation Civil Engineering: Elective Compulsor | v | |
| | | ecialisation Traffic and Mobility: Elective Compulsion | | |
| | | | - | |
| | | ecialisation Water and Environment: Elective Com | pulsory | |
| | Energy and Environmental Engineering: C | | | |
| | General Engineering Science (English pro | gram, 7 semester): Specialisation Energy and Env | /iromental Engineer | ing: Compulsory |
| | General Engineering Science (English p | program, 7 semester): Specialisation Mechanica | al Engineering, Foc | us Energy Syste |
| | Elective Compulsory | | | |
| | | | | |
| | General Engineering Science (English pro | gram, 7 semester): Specialisation Process Engine | ering: Elective Com | pulsory |

| Course L0316: Power Industry | |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 1 |
| CP | 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 e-mobility)) 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 electricity generation of electrical energy classic" 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 System | ns and Energy Industry |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 10212, Bonowable En | |
|----------------------------|---|
| Course L0313: Renewable En | |
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 - Systemtechnik, Wirtschaftlichkeit, 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: Renewable En | ergy | | | |
|----------------------------|---|--|--|--|
| Тур | Recitation Section (small) | | | |
| Hrs/wk | 1 | | | |
| CP | 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 - Systemtechnik, Wirtschaftlichkeit, 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 | | | | Тур |) | Hrs/wk | C C | СР |
| Practical Course: Measurement and | d Control Systems (L1119 | 9) | | | tical Course | 2 | - | 2 |
| Measurement Technology for Mechanical Engineering (L1116) | | Lec | ture | 2 | | 3 | | |
| Measurement Technology for Mech | anical Engineering (L112 | 18) | | Rec | itation Section (large) | 1 | | 1 |
| Module Responsible | Prof. Thorsten Kern | | | | | | | |
| Admission Requirements | None | | | | | | | |
| Recommended Previous | Basic knowledge of p | hysics, chemis | try and electrica | l engineering | | | | |
| Knowledge | | | | | | | | |
| Educational Objectives | After taking part succ | essfully, stude | nts have reache | d the following le | arning results | | | |
| Professional Competence | | | | | | | | |
| Knowledge | Students are able to Calibration, Static an | | | | | nology (Quantities | s and Ur | nits, Uncertaiı |
| | They can outline the Temperature, mecha | | | | ent kinds of quantit | ies to be maesur | red (Elec | ctrical Quantil |
| | They can describe im | portant metho | ds of chemical A | nalysis (Gas Sen | sors, Spectroscopy, | Gas Chromatogra | aphy) | |
| Skills | Students can select s | uitable measu | ring methods to | given problems a | nd can use refering | measurement de | evices in | practice. |
| | The students are able | e to orally exp | lain issues in the | e subject area of | measurement tech | nology and soluti | on appro | oaches as wel |
| | place the issues into | the right conte | xt and application | on area. | | | | |
| Personal Competence | | | | | | | | |
| | | | | | | | | |
| - | Students can arrive a | t work results | in groups and do | ocument them in | a common report. | | | |
| - | Students can arrive a | t work results | in groups and do | ocument them in | a common report. | | | |
| Social Competence | Students can arrive a Students are able to t | | | | | | | |
| Social Competence Autonomy | | familiarize ther | nselves with new | w measurement t | | | | |
| Social Competence Autonomy | Students are able to the students are able to the study Ti | familiarize ther | nselves with new | w measurement t | | | | |
| Social Competence Autonomy Workload in Hours | Students are able to the students are able to the study Till of the study Till of the study Till of the study | familiarize ther ime 110, Study Form | nselves with new Time in Lecture | w measurement t | | | | |
| Social Competence Autonomy Workload in Hours Credit points | Students are able to I Independent Study Ti 6 | familiarize ther ime 110, Study Form Subject th | nselves with new Time in Lecture c eoretical and | w measurement t 2 70 | | | | |
| Social Competence Autonomy Workload in Hours Credit points Course achievement | Students are able to 1 Independent Study Ti 6 Compulsory Bonus Yes None | familiarize ther ime 110, Study Form Subject th practical wor | nselves with new Time in Lecture eoretical and 'k | w measurement t 2 70 | | | | |
| Social Competence Autonomy Workload in Hours Credit points Course achievement | Students are able to the students are able to the study Till of the study Till of the study Till of the study | familiarize ther ime 110, Study Form Subject th practical wor | nselves with new Time in Lecture eoretical and 'k | w measurement t 2 70 | | | | |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and | Students are able to 1 Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar | familiarize ther ime 110, Study Form Subject th practical wor | nselves with new Time in Lecture eoretical and 'k | w measurement t 2 70 | | | | |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination | Students are able to 1 Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar | familiarize ther ime 110, Study Form Subject th practical wor | nselves with new Time in Lecture eoretical and 'k | w measurement t 2 70 | | | | |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Students are able to 1 Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering | familiarize ther ime 110, Study Form Subject th practical wo nd practical wo Science (Germ | nselves with new r Time in Lecture eoretical and rk rk an program, 7 se | w measurement t | echnologies. | | | |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Students are able to 1 Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering | familiarize ther ime 110, Study Form Subject th practical wo nd practical wo Science (Germ Science (Germ | nselves with new r Time in Lecture eoretical and rk rk an program, 7 se an program, 7 se | w measurement t | echnologies. isation Mechanical B isation Biomedical E | ingineering: Com | pulsory | |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Students are able to 1 Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering General Engineering | familiarize ther ime 110, Study Form Subject th practical wo nd practical wo Science (Germ Science (Germ Science (Germ | nselves with new r Time in Lecture eoretical and rk rk an program, 7 se an program, 7 se an program, 7 se | w measurement t 2 70 Description emester): Special emester): Special emester): Special | echnologies. isation Mechanical B isation Biomedical E | ingineering: Com | pulsory | : Compulsory |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Students are able to 1 Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical Engineering | familiarize ther ime 110, Study Form Subject th practical wo nd practical wo Science (Germ Science (Germ Science (Germ gineering: Cor | nselves with new r Time in Lecture eoretical and rk rk an program, 7 se an program, 7 se an program, 7 se an program, 7 se | w measurement t | echnologies. isation Mechanical B isation Biomedical E isation Energy and B | ingineering: Com | pulsory | : Compulsory |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Students are able to 1 Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering General Engineering Digital Mechanical En Energy and Environm | familiarize ther ime 110, Study Form Subject th practical wo nd practical wo Science (Germ Science (Germ Science (Germ gineering: Cor iental Engineer | nselves with new r Time in Lecture eoretical and rk rk an program, 7 se an program, 7 se | w measurement t 2 70 Description emester): Special emester): Special emester): Special compulsory ication: Compulso | echnologies. isation Mechanical B isation Biomedical E isation Energy and B | ingineering: Com | pulsory | : Compulsory |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Students are able to 1 Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: | familiarize ther ime 110, Study Form Subject th practical wo nd practical wo Science (Germ Science (Germ Science (Germ science (Germ ugineering: Cor ugineering: Cor ugineering: Cor ugineering: Cor ugineering: Cor | nselves with new rime in Lecture eoretical and rk rk an program, 7 se an program, 7 se an program, 7 se e Qualification: C ing: Core Qualifi Mechatronics: C | w measurement t 2 70 Description emester): Special emester): Special emester): Special compulsory ication: Compulsory ication: Compulsory | echnologies. isation Mechanical E isation Biomedical E isation Energy and f | ingineering: Com | pulsory | : Compulsory |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Students are able to to Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: | familiarize ther ime 110, Study Form Subject th practical wo nd practical wo Science (Germ Science (Germ Science (Germ specialisation Specialisation | nselves with new r Time in Lecture eoretical and rk rk an program, 7 se an program, 7 se an program, 7 se e Qualification: C ing: Core Qualifi Mechatronics: C Mechanical Engi | w measurement t 2 70 Description emester): Special emester): Special emester): Special compulsory ication: Compulsory ineering: Compulsory | echnologies. isation Mechanical E isation Biomedical E isation Energy and f pry sory | ingineering: Com | pulsory | : Compulsory |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Students are able to to Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: | familiarize ther ime 110, Study Form Subject th practical wo nd practical wo do practical wo Science (Germ Science (Germ Science (Germ specialisation Specialisation Specialisation | mselves with new Time in Lecture eoretical and k rk an program, 7 se an progra | w measurement t 2 70 Description emester): Special emester): Special emester): Special compulsory ication: Compulsory ication: Compulsory ineering: Compulsory ineering: Elective | echnologies. isation Mechanical E isation Biomedical E isation Energy and E isation Energy and E sory Compulsory | ingineering: Com | pulsory | |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Students are able to 1 Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering | familiarize ther ime 110, Study Form Subject th practical wo nd practical wo Science (Germ Science (Germ Science (Germ Science (Germ specialisation Specialisation Specialisation Science (Englis | nselves with new Time in Lecture eoretical and k rk an program, 7 se an program, 7 se an program, 7 se an program, 7 se e Qualification: C ing: Core Qualifi Mechatronics: C Mechanical Engi Biomedical Engi th program, 7 se | w measurement t 2 70 Description eemester): Special emester): Special emester): Special Compulsory ication: Compulsory ication: Compulsory ineering: Compulsory ineering: Elective mester): Speciali | echnologies. isation Mechanical E isation Biomedical E isation Energy and E ory Sory Compulsory sation Energy and E | ingineering: Com Enviromental Eng nviromental Engi | pulsory ineering neering: | |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Students are able to to Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering | familiarize ther ime 110, Study Form Subject th practical wo nd practical wo do practical wo Science (Germ Science (Germ Science (Germ Science (Germ specialisation Specialisation Specialisation Science (Englis Science (Englis | nselves with new Time in Lecture eoretical and k rk an program, 7 se an program, 7 se an program, 7 se e Qualification: C ing: Core Qualifi Mechatronics: C Mechanical Engi Biomedical Engi th program, 7 se th program, 7 se | w measurement t 2 70 Description eemester): Special emester): Special emester): Special Compulsory ication: Compulsory ication: Compulsory ineering: Compulsory ineering: Elective mester): Speciali mester): Speciali | echnologies. isation Mechanical E isation Biomedical E isation Energy and I pry Sory Compulsory sation Energy and E sation Mechanical E | ingineering: Com Enviromental Eng nviromental Engi ngineering: Comp | pulsory ineering neering: pulsory | |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Students are able to to Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering General Engineering General Engineering | familiarize ther ime 110, Study Form Subject th practical wo nd practical wo do practical wo Science (Germ Science (Germ Science (Germ Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis | nselves with new Time in Lecture eoretical and k rk an program, 7 se an program, 7 se an program, 7 se e Qualification: C ing: Core Qualifi Mechatronics: C Mechanical Engi Biomedical Engi h program, 7 se th program, 7 se | w measurement t 2 70 Description emester): Special emester): Special emester): Special Compulsory ication: Compulsory ication: Compulsory ineering: Elective mester): Speciali mester): Speciali mester): Speciali | echnologies. isation Mechanical E isation Biomedical E isation Energy and I pry Sory Compulsory sation Energy and E sation Mechanical E sation Biomedical Er | ingineering: Com Enviromental Eng nviromental Engi ngineering: Comp ngineering: Comp | pulsory ineering neering: pulsory | |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Students are able to to Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering General Engineering General Engineering General Engineering | familiarize ther ime 110, Study Form Subject the practical wor and practical wor do practical wor Science (Germ Science (Germ Science (Germ Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis Science (Englis | nselves with new Time in Lecture eoretical and k rk an program, 7 se an program, 7 se an program, 7 se an program, 7 se ing: Core Qualifi Mechatronics: C Mechanical Engi Biomedical Engi ih program, 7 se ih program, 7 se ih program, 7 se ih program, 7 se | w measurement t 2 70 Description emester): Special emester): Special emester): Special Compulsory ication: Compulsory ication: Compulsory ineering: Elective mester): Speciali mester): Speciali mester): Speciali mester): Speciali | echnologies. isation Mechanical E isation Biomedical E isation Energy and I pry Sory Compulsory sation Energy and E sation Mechanical E sation Biomedical E sation Mechatronics | ingineering: Com Enviromental Engi nviromental Engi ngineering: Comp ngineering: Comp : Compulsory | neering pulsory neering: pulsory pulsory | |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Students are able to to Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering | familiarize ther ime 110, Study Form Subject the practical wor and practical wor do practical wor Science (Germ Science (Germ Science (Germ Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis Science (Englis Science (Englis | nselves with new Time in Lecture eoretical and k rk an program, 7 se an program, 7 se an program, 7 se an program, 7 se ing: Core Qualifi Mechatronics: C Mechanical Engi Biomedical Engi ih program, 7 se ih program, 7 se ih program, 7 se ih program, 7 se ih program, 7 se | w measurement t 2 70 Description emester): Special emester): Special emester): Special Compulsory ication: Compulsory ication: Compulsory ineering: Elective mester): Speciali mester): Speciali mester): Speciali mester): Speciali mester): Speciali mester): Speciali | echnologies. isation Mechanical E isation Biomedical E isation Energy and I pry Sory Compulsory sation Energy and E sation Mechanical E sation Mechatronics sation Mechatronics | ingineering: Com Enviromental Engi nyiromental Engi ngineering: Comp ngineering: Comp : Compulsory ngineering: Comp | neering: pulsory pulsory pulsory pulsory | Compulsory |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Students are able to to Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering | familiarize ther ime 110, Study Form Subject th practical wo nd practical wo do practical wo Science (Germ Science (Germ Science (Germ Science (Germ Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis Science (Englis Science (Englis Science (Englis | mselves with new Time in Lecture eoretical and tk rk an program, 7 se an program, 7 se an program, 7 se an program, 7 se ing: Core Qualifi Mechatronics: C Mechanical Engi Biomedical Engi ih program, 7 se ih program, 7 se | w measurement t 2 70 Description Description Description Description Description Description Description Description Special mester): Special mester): Special | echnologies. isation Mechanical E isation Biomedical E isation Energy and E sation Energy and E sory Compulsory sation Energy and E sation Mechanical E sation Mechanical E sation Mechanical E sation Mechanical E sation Biomedical E | ingineering: Com Enviromental Engi nyiromental Engi ngineering: Comp ngineering: Comp : Compulsory ngineering: Comp ngineering: Electi | neering: pulsory pulsory pulsory pulsory | Compulsory |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Students are able to to Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering Sciences Sciences Sciences Sciences General Engineering General Engineering Sciences | familiarize ther ime 110, Study Form Subject the practical wor and practical wor do practical wor science (Germ Science (Germ Science (Germ Science (Germ Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis Science (Englis Science (Englis Science (Englis Science (Englis Science (Englis | mselves with new Time in Lecture eoretical and tk rk an program, 7 se an program, 7 se an program, 7 se e Qualification: C ing: Core Qualifi Mechatronics: C Mechanical Engi Biomedical Engi Biomedical Engi sh program, 7 se sh program, 7 se | w measurement t | echnologies. isation Mechanical E isation Biomedical E isation Energy and E sation Energy and E sory Compulsory sation Energy and E sation Mechanical E sation Mechanical E sation Mechanical E sation Mechanical E sation Biomedical E | ingineering: Com Enviromental Engi nyiromental Engi ngineering: Comp ngineering: Comp : Compulsory ngineering: Comp ngineering: Electi | neering: pulsory pulsory pulsory pulsory | Compulsory |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Students are able to to Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering Consta Engineering Science: | familiarize ther ime 110, Study Form Subject the practical wor and practical wor do practical wor do practical wor Science (Germ Science (Germ Science (Germ Science (Germ Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis | mselves with new Time in Lecture eoretical and tk rk an program, 7 se an program, 7 se an program, 7 se e Qualification: C ing: Core Qualifi Mechatronics: C Mechanical Engi Biomedical Engi Biomedical Engi sh program, 7 se sh progra | w measurement t | echnologies. isation Mechanical E isation Biomedical E isation Energy and E sation Energy and E sory Compulsory sation Energy and E sation Mechanical E sation Mechanical E sation Mechanical E sation Mechanical E sation Biomedical E | ingineering: Com Enviromental Engi nyiromental Engi ngineering: Comp ngineering: Comp : Compulsory ngineering: Comp ngineering: Electi | neering: pulsory pulsory pulsory pulsory | Compulsory |
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| | Practical Course |
|-------------------|---|
| Hrs/wk | |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Thorsten Kern |
| Language | DE |
| Cycle | WiSe/SoSe |
| Content | Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseo pollutants in automotive exhaust are used. |
| | Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine v be investigated. The starting will be simulated on a PC and compared with measurement. |
| | Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will be understood and applications wi 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 am Arbeitsplatz. 2. Auf Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974 Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenbu Verlag, München-Wien, 1979 Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltur Gebrauchs- und Bedienungsanweisungen VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 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 Verlag, Heidelberg, 1984 Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988 Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989 Versuch 4: Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen |

| Course L1116: Measurement | : Technology for Mechanical Engineering | | | | |
|---------------------------|---|--|--|--|--|
| Тур | Lecture | | | | |
| Hrs/wk | | | | | |
| СР | 3 | | | | |
| | | | | | |
| | of. Thorsten Kern, Dennis Kähler | | | | |
| Language | | | | | |
| Cycle | Vise 1 Fundamentals | | | | |
| Content | 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 | | | | |
| | i Data Transmission | | | | |
| | 3 Measurement of Nonelectric Quantities | | | | |
| | 3.1 Temperature | | | | |
| | .2 Length, Displacement, Angle | | | | |
| | 3.3 Strain, Force, Pressure | | | | |
| | 3.4 Flow | | | | |
| | 3.5 Time, Frequency | | | | |
| Literature | Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springer, 2006, ISBN: 978-3-540-34055- 3. | | | | |
| | Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 978-3486217940. | | | | |

| Course L1118: Measurement | ourse L1118: Measurement Technology for Mechanical Engineering | | |
|---------------------------|--|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| CP | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Thorsten Kern | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | |
|--|---|---|--------------------|---|
| Title | | Tun | Hrs/wk | СР |
| Computational Fluid Dynamics I (L | 235) | Typ Lecture | 2 | 3 |
| Computational Fluid Dynamics I (L0419) | | Recitation Section (large) | 2 | 3 |
| Module Responsible | Prof. Thomas Rung | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | Mathematical Methods for Engineers | | | |
| | Fundamentals of Differential/integral calcul | lus and series expansions | | |
| Educational Objectives | After taking part successfully, students have reach | hed the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are able to list the basic numerics of | f partial differential equations. | | |
| | | | | |
| | | | | |
| Skills | The students are able develop appropriate numer | ical integration in space and time for the go | overning partial d | ifferential equatio |
| | They can code computational algorithms in a strue | ctured way. | | |
| | | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| | The students can arrive at work results in groups | and document them. | | |
| social competence | | | | |
| | | | | |
| Διιτοποπγ | The students can independently analyse approach | hes to solving specific problems | | |
| Autonomy | The stadents can independently analyse approach | ies to solving specific prosterio. | | |
| | | | | |
| | | | | |
| | | | | |
| | Independent Study Time 124, Study Time in Lectu | ure 56 | | |
| Credit points | | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 2h | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 | <pre>semester): Specialisation Mechanical Engin</pre> | neering, Focus Th | eoretical Mechani |
| Following Curricula | Engineering: Elective Compulsory | | | |
| | General Engineering Science (German program | , 7 semester): Specialisation Mechanical | Engineering, Foc | us Aircraft Syste |
| | Engineering: Elective Compulsory | | | |
| | General Engineering Science (German program, Elective Compulsory | , / semester): Specialisation Mechanical | Engineering, Foc | us Energy Syster |
| | General Engineering Science (German program, 7 | semester). Specialisation Naval Architectur | e: Compulson | |
| | General Engineering Science (German program, 7 | | | ring: Compulsory |
| | Energy Systems: Technical Complementary Cours | | Strenta Engineer | g. compuisory |
| | General Engineering Science (English program, 7 | | mental Engineeri | ing: Compulsorv |
| | General Engineering Science (English program, | | - | • • • |
| | Elective Compulsory | • | 5 5 | 3, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, |
| | General Engineering Science (English program, 7 | semester): Specialisation Naval Architecture | e: Compulsory | |
| | General Engineering Science (English program, | • | | us Aircraft Syste |
| | Engineering: Elective Compulsory | | | |
| | Mechanical Engineering: Specialisation Energy Sys | stems: Elective Compulsory | | |
| | Mechanical Engineering: Specialisation Aircraft Sy | stems Engineering: Elective Compulsory | | |
| | | | | |
| | Naval Architecture: Core Qualification: Compulsor | У | | |

| Course L0235: Computationa | Course L0235: Computational Fluid Dynamics I | | |
|----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| CP | 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. | | |
| | Partial differential equations Foundations of finite numerical approximations Computation of potential flows Introduction of finite-differences Approximation of convective, diffusive and transient transport processes Formulation of boundary conditions and initial conditions Assembly and solution of algebraic equation systems Facets of weighted -residual approaches Finite volume methods Basics of grid generation | | |
| Literature | Ferziger and Peric: Computational Methods for Fluid Dynamics, Springer | | |

| Course L0419: Computationa | urse 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 | | |

| Module M1275: Envir | onmental Tech | nology | | | |
|---|------------------------|----------------------------|--|--------------------------|---------------------|
| | | | | | |
| Courses | | | | | |
| Fitle | | | Typ | Hrs/wk | CP |
| Practical Exercise Environmental To Environmental Technologie (L0326 | 5, | | Practical Course Lecture | 1 2 | 1 2 |
| Module Responsible | 1 | si++ | Lecture | L | 2 |
| Admission Requirements | | | | | |
| Recommended Previous | | manic/organic chemistry | and biology | | |
| Knowledge | i undumentais or mor | gunic, organic chemistry | and biology | | |
| | After taking part succ | ressfully students have i | reached the following learning results | | |
| Professional Competence | Arter taking part sact | costany, statents have i | reaction and the following rearring results | | |
| | With the completion | of this modul the student | ts obtain profound knowledge of environm | ental technology. They | are able to descri |
| Knowledge | | | nt. Students can give an overview of scier | | |
| | | nem to related methods. | | | cui mey cui expi |
| | | | | | |
| Skills | | | anagement and mitigation measures for | | - |
| | - | | ssess the potential of pollutants to migra | | |
| | | | conmental Technology contributes to susta | inable development, a | and they can pres |
| | and defend these opi | inons in front of and agai | nst the group. | | |
| Personal Competence | | | | | |
| Social Competence | The students are able | e to discuss the various t | echnical and scientific tasks, both subject- | specific and multidisci | plinary. They are a |
| | to develop different a | approaches to the task as | s a group as well as to discuss their theore | tical or practical imple | mentation. |
| | | | | | |
| Autonomy | Students can indepen | ndently exploit sources a | bout of the subject, acquire the particular | knowledge and tranfer | r it to new problem |
| Workload in Hours | Independent Study T | ime 48, Study Time in Le | ecture 42 | | |
| Credit points | 3 | | | | |
| Course achievement | Compulsory Bonus | Form | Description | | |
| | Yes None | Subject theoretical | and | | |
| | | practical work | | | |
| | Written exam | | | | |
| Examination duration and | 1 hour | | | | |
| scale | | | | | |
| - | | | m, 7 semester): Specialisation Process Eng | - | |
| Following Curricula | | | m, 7 semester): Specialisation Bioprocess | | |
| | | | m, 7 semester): Specialisation Energy and | Enviromental Enginee | ring: Compulsory |
| | | ng: Core Qualification: El | | | |
| | 3, | 5 5 | Qualification: Compulsory | | |
| | | | n, 7 semester): Specialisation Bioprocess E | | |
| | | | n, 7 semester): Specialisation Energy and I | - | |
| | | | n, 7 semester): Specialisation Process Engi | neering: Elective Com | puisory |
| | FIOLESS Engineering: | Core Qualification: Elect | ive compulsory | | |

| ourse 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 | Prof. Martin Kaltschmitt, Dr. Isabel Höfer | |
| Language | DE | |
| Cycle | SoSe | |
| Content | The practical course Environmental Engineering currently consists of 6 experiments, which deal with the different focal points of environmental engineering in the areas of air, water, soil, environment, biomass and noise. The following experiments are carried out for this purpose: Determination of the calorific value of biomass, soil purification, waste water treatment, noise emissions, plastic waste, biowaste. Translated with www.DeepL.com/Translator (free version) 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 | | |

| Course L0326: Environmenta | I Technologie | |
|----------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Martin Kaltschmitt, Dr. Isabel Höfer | |
| 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 | | | | |
|---|---|--|--|---|
| ïtle | | Тур | Hrs/wk | СР |
| hermal Separation Processes (L01 | | Lecture | 2 | 2 |
| hermal Separation Processes (L01 | | Recitation Section (small) | 2 | 2 1 |
| hermal Separation Processes (L01 eparation Processes (L1159) | 41) | Recitation Section (large) Practical Course | 1 | 1 |
| Module Responsible | Prof. Irina Smirnova | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Recommended requirements: Thermodynamics I | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have rea | ched the following learning results | | |
| Professional Competence | | | | |
| Knowledge | | | | |
| | The students can distinguish and descriation The students develop an understanding fenergy demand of a process, the possibilitient They have good knowledge of designing not state the students of the students of | or the course of concentration during a ties of energy saving, and the selection o | separation process, f separation systems | the estimation of t |
| Skills | Using the gained knowledge the students close the associated energy and material The students can use different graphica theoretical stages required They can select and design a basic type disadvantages of the process The students are capable to obtain indep tables) They can calculate continuous and discontered the students are able to prove their theore the students are able to discuss the theore colloquium. | balances I methods for the designing of a separ e of thermal separation process for a g endently the needed material properties tinuous processes etical knowledge in the experimental lab | ation process and d iven case based on from appropriate so work. | lefine the amount the advantages a purces (diagrams a |
| Personal Competence Social Competence | The students can work technical assignment | | | utorial |
| Autonomy | The students are able to carry out practical lab work in small groups and organize a functional division of labor betwee them. They are able to discuss their results and to document them scientifically in a report. | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lectu | ıre 84 | | |
| Credit points | | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 120 minutes; theoretical questions and calculation | ons | | |
| Assignment for the Following Curricula | General Engineering Science (German program, General Engineering Science (German program, General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Bioprocess Engineering: Core Qualification: Comp Energy and Environmental Engineering: Core Qu General Engineering Science (English program, 7 | 7 semester): Specialisation Bioprocess E 7 semester): Specialisation Green Techn m, 7 semester): Specialisation Green 7 semester): Specialisation Energy and E pulsory alification: Elective Compulsory | ngineering: Compulso ologies, Focus Renew Technologies, Focus nviromental Enginee | able Energy: Elect Renewable Energ ring: Compulsory |

Process Engineering: Core Qualification: Compulsory

L

| Course L0118: Thermal Sepa | iration Processes |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Irina Smirnova |
| Language | DE |
| | WiSe |
| Content | |
| 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 Sepa | ration Processes |
|---------------------------|--|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| CP | 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 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 |

| Course L0141: Thermal Sepa | ration Processes |
|----------------------------|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| CP | 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 Pr | ocesses |
|-----------------------------|---|
| Тур | Practical Course |
| Hrs/wk | 1 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Irina Smirnova |
| Language | DE/EN |
| Cycle | WiSe |
| | 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 car 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 |
| Literature | Energy demand of separation processes Advance overview of separation processes Selection of separation processes Selection of separation processes 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 separatio 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 | Ту | 'p | Hrs/wk | СР |
| Environmental Assessment (L0860) | | cture | 2 | 2 |
| Environmental Assessment (L1054) | Rec | citation Section (small) | 1 | 1 |
| Module Responsible | Prof. Martin Kaltschmitt | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Fundamentals of inorganic/organic chemistry and biology | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the following le | earning results | | |
| Professional Competence | | | | |
| Knowledge | With the completion of this module the students acquire in-dep environmental problems which might occur from production proces about the methodological diversity and are competent in dealing wii impacts. Besides the students are able to estimate the complexity of difficulties with their measurement. | sses, projects or construction ith different methods and inst | measures. The ruments to asse | y have knowled ess environment |
| Skills | afficulties with their measurement. The students are able to select a suitable method for the respective case from the variety of assessment methods. Thereby the can develop suitable solutions for managing and mitigating environmental problems in a business context. They are able to can out Life Cycle Impact Assessments independently and can apply the software programs OpenLCA and the database EcoInver After finishing the course the students have the competence to critically judge research results or other publications of environmental impacts. | | | |
| Personal Competence | | | | |
| Social Competence | The students are able to discuss the various technical and scientific to develop jointly different solutions and to discuss their theoretic topics, the students receive insights into the multi-layered issues of Their sensitivity and consciousness towards these subjects are rais social responsibilities in their role as engineers. | ical or practical implementat f the environment protection | ion. Due to the and the concep | e selected lecture selected lecture selected lecture selected lecture selected lecture selected sele |
| Autonomy | The students learn to research, process and present a scientific t scientific to scientific work. They can solve an environmental problem in a busine | | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | | |
| Credit points | 3 | | | |
| Course achievement | | | | |
| Examination | | | | |
| Examination duration and | | | | |
| scale | | | | |
| | General Engineering Science (German program, 7 semester); Specia | alisation Process Engineering: | Elective Compu | lsorv |
| 3 | General Engineering Science (German program, 7 semester): Specia General Engineering Science (German program, 7 semester): Specia | <u> </u> | | , |
| | General Engineering Science (German program, 7 semester): Specia | | - | |
| | Bioprocess Engineering: Core Qualification: Elective Compulsory | | 2 | |
| | Energy and Environmental Engineering: Core Qualification: Compuls | ory | | |
| | General Engineering Science (English program, 7 semester): Special | | g: Elective Com | pulsory |
| | General Engineering Science (English program, 7 semester): Speciali | | - | |
| | General Engineering Science (English program, 7 semester): Speciali Process Engineering: Core Qualification: Elective Compulsory | | | |

| Course L0860: Environmenta | I 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 | WiSe/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: Environmenta | Il Assessment |
|----------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Martin Kaltschmitt, Dr. Anne Rödl |
| Language | DE |
| Cycle | WiSe |
| 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 M0538: Heat | and Mass Transfer | | | |
|--|--|---|---|---|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Heat and Mass Transfer (L0101) | | Lecture | 2 | 2 |
| Heat and Mass Transfer (L0102) | | Recitation Section (small) | 1 | 2 |
| Heat and Mass Transfer (L1868) | | Recitation Section (large) | 1 | 2 |
| Module Responsible | Prof. Irina Smirnova | | | |
| Admission Requirements | | | | |
| | Basic knowledge: Technical Thermodynamics | | | |
| Knowledge | | | | |
| | | | | |
| | After taking part successfully, students have reached t | he following learning results | | |
| Professional Competence Knowledge | | | | |
| Skills | heat exchanger, chemical reactors). They are capable of distinguish and characterize transfer and thermal radiation. The students have the ability to explain the qualitative and quantitative by using suitable may an addition the analogy between here. They are able to depict the analogy between here and to balance the corresponding energy and may and to calculate the corresponding heat flows. Using dimensionless quantities, the students care. They are able to distinguish between diffusion, for the description and design of apparatus (e.g.) In this context, the students are capable to choor application considering their advantages and distinguish betw, steady-state. The students are capable to connect their k particular the courses thermodynamics, fluid r problems. | physical basis for mass transfer in or ass transfer theories. at- and mass transfer and to describe of boundaries for a given transport pro- ass flow, respectively. r problems (e.g. heated chemical read on execute scaling up of technical proce convective mass transition and mass f extraction column, rectification colum use and design fundamental types of h iadvantages, respectively. e and non-steady-state processes in pr mowledge obtained in this course | detail and to de complex linked pu oblem by using th ctors, temperatur esses or apparatu cransfer. They can in). eat and mass exi occedural apparat with knowlegde | scribe mass tran rocesses in detail. he gained knowle re alteration in flu is. n use this knowled changer for a spec- tus. of other courses |
| Personal Competence Social Competence | The students are capable to work on subject-sp manner to tutors and other students. | ecific challenges in teams and to pre | sent the results o | orally in a reasona |
| Autonomy | The students are able to find and evaluate neces They are able to prove their level of knowled system, exam-like assignments) and on this bas | ge during the course with accompan | ying procedure | continuously (clic |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | 5 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 minutes; theoretical questions and calculations | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 sem | ester): Specialisation Process Engineer | ing: Compulsory | |
| Following Curricula | General Engineering Science (German program, 7 sem | | | ory |
| | General Engineering Science (German program, 7 sem | | | |
| | General Engineering Science (German program, 7 sem | | omental Enginee | ering: Compulsory |
| | Bioprocess Engineering: Core Qualification: Compulsor | | | |
| | Energy and Environmental Engineering: Core Qualificat | | ering: Compulse | n/ |
| | General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme | | | - |
| | General Engineering Science (English program, 7 seme | | | g. compuisory |
| | | | | |
| | Green Technologies: Energy Water Climate Core Qua | lification: Compulsory | | |
| | Green Technologies: Energy, Water, Climate: Core Qua Technomathematics: Specialisation III. Engineering Sci | | | |

| Course L0101: Heat and Mas | is 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 | 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 | |
| CP | 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 | |

| ourse L1868: Heat and Mass Transfer | | |
|-------------------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | 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 |
| Particle Technology I (L0434) | | | | Lecture | 2 | 3 |
| Particle Technology I (L0435) | | | | Recitation Section (small) | 1 | 1 |
| Particle Technology I (L0440) | | | | Practical Course | 2 | 2 |
| Module Responsible | Prof. Stefan Heinric | h | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | keine | | | | | |
| Knowledge | | | | | | |
| Educational Objectives | After taking part su | ccessfully, students ha | ve reached the following | g learning results | | |
| Professional Competence | | | | | | |
| Knowledge | After successful cor | mpletion of the module | students are able to | | | |
| | name and ex | plain processes and u | nit-operations of solids | process engineering. | | |
| | | | ibutions and to discuss | | | |
| | | | | | | |
| | | | | | | |
| Skills | Students are able to | 0 | | | | |
| | | | | | | |
| | | | | ocessing according to the d | esired solids prop | perties of the prod |
| | | | ehavior in solids process | ing steps | | |
| | document th | eir work scientifically. | | | | |
| Personal Competence | | | | | | |
| Social Competence | The students are a | able to discuss scienti | fic topics orally with ot | her students or scientific p | ersonal and to o | develop solutions |
| | technical-scientific | | | | | |
| Autonomy | Students are able to | o analyze and solve qu | estions regarding solid | particles independently. | | |
| Workload in Hours | Indopondont Study | Time 110, Study Time | in Locturo 70 | | | |
| Credit points | | Time 110, Study Time | III Lecture 70 | | | |
| Course achievement | Compulsory Bonus | Form | Description | | | |
| course acmevement | Yes None | Written elaboration | | (pro Versuch ein Bericht) à | 5-10 Seiten | |
| Examination | Written exam | | | • | | |
| Examination duration and | 90 minutes | | | | | |
| scale | | | | | | |
| Assignment for the | General Engineerin | g Science (German pro | gram, 7 semester): Spe | cialisation Process Engineer | ing: Compulsory | |
| Following Curricula | - | | - | cialisation Bioprocess Engin | | ory |
| 2 | - | | - | ecialisation Green Technolo | | - |
| | Engineering: Electiv | | 5 | | | |
| | | | gram, 7 semester): Spe | cialisation Energy and Envir | omental Enginee | ring: Compulsory |
| | - | ering: Core Qualification | - | | 5 | , |
| | | - | ore Qualification: Electiv | e Compulsory | | |
| | | | | ialisation Bioprocess Engine | ering: Compulso | ry |
| | - | | | ialisation Energy and Enviro | | - |
| | - | | | ialisation Process Engineeri | - | 5 |
| | General Engineerin | y science (Enulish broc | | | | |
| | - | | te: Specialisation Water | - | ing. compaisory | |

| Course L0434: Particle Techr | nology I |
|------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 | |
| CP | 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 Techr | nology I |
|------------------------------|--|
| Тур | Practical Course |
| Hrs/wk | 2 |
| CP | 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. |

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.

| Courses | | | | |
|--|---|---|----------------------|-----------------------|
| | | T | Hara karda | |
| Title Discrete Algebraic Structures (L01) | 64) | Typ Lecture | Hrs/wk | СР 3 |
| Discrete Algebraic Structures (LOI) | | Recitation Section (small) | | 3 |
| | Prof. Karl-Heinz Zimmermann | | | |
| Admission Requirements | | | | |
| | Mathematics from High School. | | | |
| Knowledge | · · · · · · · · · · · · · · · · · · · | | | |
| Educational Objectives | After taking part successfully, students have | e reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students know the important basics of | f discrete algebraic structures including elem | entary combinatorial | structures, monoid |
| | groups, rings, fields, finite fields, and vector | r spaces. They also know specific structures li | ke sub sum-, and qu | lotient structures an |
| | homomorphisms. | | | |
| Skills | Students are able to formalize and analyze basic discrete algebraic structures. | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to solve specific problems | s alone or in a group and to present the result | ts accordingly. | |
| Autonomy | Students are able to acquire new knowled | dge from specific standard books and to as | sociato the acquires | t knowledge to oth |
| Autonomy | classes. | age from specific standard books and to as | sociate the acquired | Rhowledge to othe |
| | | | | |
| | | | | |
| Workload in Hours | Independent Study Time 124, Study Time ir | n Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German prog | ram, 7 semester): Specialisation Computer So | ience: Compulsory | |
| Following Curricula | Computer Science: Core Qualification: Com | pulsory | | |
| | Data Science: Core Qualification: Compulso | ry | | |
| | General Engineering Science (English progr | am, 7 semester): Specialisation Computer Sci | ence: Compulsory | |
| | Computational Science and Engineering: Co | pre Qualification: Compulsory | | |
| | Orientierungsstudium: Core Qualification: E | lective Compulsory | | |

| Course L0164: Discrete Algebraic Structures | | |
|---|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| CP | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Karl-Heinz Zimmermann | |
| Language | DE/EN | |
| 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/EN | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|--------------------------------|---|--|--|---|
| Title | | Тур | Hrs/wk | СР |
| Computer Engineering (L0321) | | Lecture | 3 | 4 |
| Computer Engineering (L0324) | | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Heiko Falk | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge in electrical engineering | | | |
| Knowledge | | | | |
| | After taking part successfully, students have reached | the following learning results | | |
| Professional Competence | This module deals with the foundations of the funct | encling of computing systems. It can | re the lower from | the ecompluie |
| Kilowieuge | This module deals with the foundations of the functi programming down to gates. The module includes the | | is the layers from | i the assembly-le |
| | Introduction | | | |
| | Combinational logic: Gates, Boolean algebra, Bo Sequential logic: Flip flops, automata, systemata | - | combinational netv | vorks |
| | Sequential logic: Flip-flops, automata, systemat Technological foundations | | | |
| | Computer arithmetic: Integer addition, subtract | ion, multiplication and division | | |
| | Basics of computer architecture: Programming | | pipelining | |
| | Memories: Memory hierarchies, SRAM, DRAM, c | aches | | |
| | • Input/output: I/O from the perspective of the CF | U, principles of passing data, point-to-p | point connections, | busses |
| Skills | The students perceive computer systems from the arc | hitect's perspective, i.e., they identify | the internal struct | ure and the physi |
| | composition of computer systems. The students can a | | | |
| | collection of few and simple components. They are a | | | |
| | today's computing systems - from gates and circuits u | p to complete processors. | | |
| | After successful completion of the module, the stude | ents are able to judge the interdenend | dencies between : | a physical compu |
| | system and the software executed on it. In particular | | | |
| | on the hardware-centric abstraction layers from the a | | | |
| | the impact that these low abstraction levels have on a | n entire system's performance and to | propose feasible o | ptions. |
| Personal Competence | | | | |
| | Students are able to solve similar problems alone or ir | a group and to present the results acc | cordinaly | |
| Social competence | students are usie to solve similar problems alone or in | a group and to present the results act | corunigiy. | |
| Autonomy | Students are able to acquire new knowledge from spe | cific literature and to associate this kno | owledge with other | classes. |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 5 | 6 | | |
| Credit points | | | | |
| Course achievement | Compulsory Bonus Form De | scription | | |
| | Yes 10 % Excercises | | | |
| | Written exam | | | |
| Examination duration and scale | 90 minutes, contents of course and labs | | | |
| | General Engineering Science (German program, 7 sen | actor): Specialization Computer Science | co: Compulsory | |
| | General Engineering Science (German program, 7 sen | | | rv |
| , , | General Engineering Science (German program, 7 sen | | | . , |
| | General Engineering Science (German program, 7 sen | nester): Specialisation Electrical Engine | ering: Compulsory | |
| | General Engineering Science (German program, 7 sen | nester): Specialisation Biomedical Engir | neering: Compulso | ry |
| | General Engineering Science (German program, 7 sen | nester): Specialisation Energy and Envi | romental Engineer | ing: Compulsory |
| | General Engineering Science (German program, 7 sen | nester): Specialisation Process Engineer | ring: Compulsory | |
| | General Engineering Science (German program, 7 | semester): Specialisation Mechanic | al Engineering, F | ocus Mechatroni |
| | Compulsory General Engineering Science (German program, 7 | semester): Specialisation Mechanica | al Engineering, F | ocus Biomechani |
| | Compulsory | | | |
| | | | Engineering, Foc | |
| | General Engineering Science (German program, 7 | semester): Specialisation Mechanical | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | us Aircraft Syste |
| | Engineering: Compulsory | · | | |
| | Engineering: Compulsory General Engineering Science (German program, | · | | |
| | Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory | 7 semester): Specialisation Mechani | cal Engineering, | Focus Materials |
| | Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser | 7 semester): Specialisation Mechani | cal Engineering, | Focus Materials |
| | Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory | 7 semester): Specialisation Mechani nester): Specialisation Mechanical Engi | cal Engineering, neering, Focus Th | Focus Materials |
| | Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory | 7 semester): Specialisation Mechani nester): Specialisation Mechanical Engi | cal Engineering, neering, Focus Th | Focus Materials |
| | Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 se | 7 semester): Specialisation Mechani nester): Specialisation Mechanical Engi mester): Specialisation Mechanical Eng | cal Engineering, neering, Focus Th gineering, Focus P | Focus Materials eoretical Mechani roduct Developm |
| | Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 se and Production: Compulsory | 7 semester): Specialisation Mechani nester): Specialisation Mechanical Engi mester): Specialisation Mechanical Eng semester): Specialisation Mechanical | cal Engineering, neering, Focus Th gineering, Focus P Engineering, Focu | Focus Materials eoretical Mechani roduct Developm us Energy Syster |
| | Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 se and Production: Compulsory General Engineering Science (German program, 7 Compulsory | 7 semester): Specialisation Mechani nester): Specialisation Mechanical Engi mester): Specialisation Mechanical Eng semester): Specialisation Mechanical | cal Engineering, neering, Focus Th gineering, Focus P Engineering, Focu | Focus Materials eoretical Mechani roduct Developm us Energy Syster |
| | Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 se and Production: Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 senation program, 7 senation | 7 semester): Specialisation Mechani nester): Specialisation Mechanical Engi mester): Specialisation Mechanical Eng semester): Specialisation Mechanical semester): Specialisation Mechanical | cal Engineering, neering, Focus Th gineering, Focus P Engineering, Focu Engineering, Focu | Focus Materials eoretical Mechani roduct Developm us Energy Syster |
| | Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 se and Production: Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 compulsory General Engineering Science (German program, 7 sen Computer Science: Core Qualification: Compulsory | 7 semester): Specialisation Mechani nester): Specialisation Mechanical Engi mester): Specialisation Mechanical Eng semester): Specialisation Mechanical semester): Specialisation Mechanical | cal Engineering, neering, Focus Th gineering, Focus P Engineering, Focu Engineering, Focu | Focus Materials eoretical Mechan roduct Developm us Energy System |
| | Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 se and Production: Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 compulsory General Engineering Science (German program, 7 sen Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory | 7 semester): Specialisation Mechanical Engi nester): Specialisation Mechanical Engi mester): Specialisation Mechanical Engi semester): Specialisation Mechanical semester): Specialisation Mechanical nester): Specialisation Civil Engineering | cal Engineering, neering, Focus Th gineering, Focus P Engineering, Focu Engineering, Focu | Focus Materials eoretical Mechan roduct Developm us Energy System |
| | Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 se and Production: Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 sen Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory | 7 semester): Specialisation Mechanical Engi nester): Specialisation Mechanical Engi mester): Specialisation Mechanical Engi semester): Specialisation Mechanical semester): Specialisation Mechanical nester): Specialisation Civil Engineering | cal Engineering, neering, Focus Th gineering, Focus P Engineering, Focu Engineering, Focu I: Compulsory | Focus Materials eoretical Mechan roduct Developm us Energy System |
| | Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 se and Production: Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 compulsory General Engineering Science (German program, 7 sen Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering Science (English program, 7 sem | 7 semester): Specialisation Mechanical Engi nester): Specialisation Mechanical Engi mester): Specialisation Mechanical Eng semester): Specialisation Mechanical semester): Specialisation Mechanical nester): Specialisation Civil Engineering | cal Engineering, neering, Focus Th gineering, Focus P Engineering, Focu Engineering, Focu I: Compulsory | Focus Materials eoretical Mechan roduct Developm us Energy System |
| | Engineering: Compulsory General Engineering Science (German program, Engineering Sciences: Compulsory General Engineering Science (German program, 7 ser Engineering: Compulsory General Engineering Science (German program, 7 se and Production: Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, 7 sen Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory | 7 semester): Specialisation Mechanical Engi nester): Specialisation Mechanical Engi mester): Specialisation Mechanical Engi semester): Specialisation Mechanical semester): Specialisation Mechanical nester): Specialisation Civil Engineering ester): Specialisation Electrical Enginee ester): Specialisation Civil Engineering: | cal Engineering, neering, Focus Th gineering, Focus P Engineering, Focu Engineering, Focu I: Compulsory Compulsory Compulsory | Focus Materials eoretical Mechani roduct Developm us Energy Syster us Energy Syster |

| G | General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory |
|---|--|
| G | General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: |
| C | Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: |
| C | Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems |
| E | Engineering: Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering |
| S | Sciences: Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: |
| C | Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development |
| а | and Production: Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical |
| E | Engineering: Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory |
| 0 | Computational Science and Engineering: Core Qualification: Compulsory |
| N | Mechatronics: Core Qualification: Compulsory |
| Т | Technomathematics: Specialisation II. Informatics: Elective Compulsory |

| Course L0321: Computer Eng | jineering |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Heiko Falk |
| Language | DE/EN |
| 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 Eng | gineering |
|----------------------------|---|
| 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/EN |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Courses | | | | |
|-----------------------------------|--|---|---------------------|----------------------|
| Title | | Turn | Hre /w/r | СР |
| Graph Theory and Optimization (L1 | 046) | Typ Lecture | Hrs/wk 2 | 3 |
| Graph Theory and Optimization (L1 | | Recitation Section (small) | 2 | 3 |
| Module Responsible | Prof. Anusch Taraz | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | Discrete Algebraic Structures | | | |
| | Mathematics I | | | |
| Educational Objectives | After taking part successfully, students have re | eached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | | | | |
| | | in Graph Theory and Optimization. They are a | ble to explain the | em using appropria |
| | examples. | | | |
| | | s between these concepts. They are capable | of illustrating the | ese connections w |
| | the help of examples. | | | |
| | They know proof strategies and can repr | roduce them. | | |
| Skills | | | | |
| | | h Theory and Optimization with the help of | the concepts stu | idied in this cours |
| | Moreover, they are capable of solving th | | | |
| | | further logical connections between the conce | | |
| | | develop and execute a suitable approach, a | ind are able to ci | ritically evaluate t |
| | results. | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to work together in te | ams. They are capable to use mathematics as | a common langua | age. |
| | | concepts according to the needs of their coo | | |
| | design examples to check and deepen t | | | |
| | 5 | 5 . | | |
| | | | | |
| Autonomy | | | | |
| | | understanding of complex concepts on their of | own. They can sp | ecify open questic |
| | precisely and know where to get help in | | | |
| | | sistence to be able to work for longer period | ls in a goal-orient | ted manner on ha |
| | problems. | | | |
| | | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Le | ecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program | n, 7 semester): Specialisation Computer Science | e: Compulsory | |
| Following Curricula | Computer Science: Core Qualification: Compute | sory | - | |
| | Computer Science: Core Qualification: Compute | sory | | |
| | Data Science: Core Qualification: Compulsory | | | |
| | General Engineering Science (English program | , 7 semester): Specialisation Computer Science | e: Compulsory | |
| | Logistics and Mobility: Specialisation Engineeri | ng Science: Elective Compulsory | | |
| | Technomathematics: Specialisation I. Mathema | atics: Elective Compulsory | | |

| urse L1046: Graph Theory | • |
|--------------------------|---|
| | Lecture |
| Hrs/wk | 2 |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Anusch Taraz |
| Language | DE/EN |
| 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 T. Cormen, Ch. Leiserson, R. Rivest, C. Stein: Algorithmen - Eine Einführung, Oldenbourg, 2013 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 | ourse 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/EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|---|--|--|--------------------|---------------------|
| Title | | Тур | Hrs/wk | СР |
| Stochastics (L0777) | | Lecture | 2 | 4 |
| Stochastics (L0778) | | Recitation Section (small) | 2 | 2 |
| Module Responsible | Prof. Marko Lindner | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Calculus | | | |
| Knowledge | Discrete algebraic structures (combinatorics) | | | |
| | Propositional logic | | | |
| | | | | |
| Educational Objectives | After taking part successfully, students have reache | d the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students can explain the main definitions of prob | | | - |
| | variables, events, dependence, independence as | | - | |
| | distributions, density functions). Students can de | | • | |
| | deviation, and moments. Students can define decis | | ÷ . | |
| | chain rule or Bayesian networks). Algorithms, or est | | | |
| | an estimator, etc. Student can describe the main i | | - | - |
| Chille | computation problem for stochastic processes. Stud | | | |
| SKIIIS | Students can apply algorithms for solving decision enough in various application contexts, i.e., students | | | |
| | enough in various application contexts, i.e., students | s can derive estimators and judge whethe | a they are applic | able of feliable. |
| Personal Competence | | | | |
| Social Competence | - Students are able to work together (e.g. on thei | r regular home work) in heterogeneousl | y composed tea | ms (i.e., teams fro |
| | different study programs and background knowledge | e) and to present their results appropriat | ely (e.g. during e | exercise class). |
| Διιτοροφγ | - Students are capable of checking their understa | anding of complex concepts on their ow | n They can so | ecify open questio |
| Autonomy | precisely and know where to get help in solving ther | | in mey can sp | certy open questio |
| | | | | |
| | - 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 go | al-oriented mann | er on hard problem |
| | | 50 | | |
| | Independent Study Time 124, Study Time in Lecture | 56 | | |
| Credit points Course achievement | | | | |
| | | | | |
| Examination | | | | |
| Examination duration and scale | 120 min | | | |
| Assignment for the | Concrol Engineering Science (Cormon program 7 or | masterly Englishing Computer Science | a Compulsor | |
| Assignment for the Following Curricula | General Engineering Science (German program, 7 se Computer Science: Core Qualification: Compulsory | emester): specialisation Computer Scienc | e. compulsory | |
| Following Curricula | Data Science: Core Qualification: Compulsory | | | |
| | General Engineering Science (English program, 7 se | mester): Specialisation Computer Science | : Compulsory | |
| | Computational Science and Engineering: Core Qualif | | . comparisony | |
| | Computational Science and Engineering: Core Qualif | | | |
| | Logistics and Mobility: Specialisation Engineering Sc | | | |
| | Theoretical Mechanical Engineering: Core Qualificati | | | |

| Course L0777: Stochastics | |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Dr. Christian Seifert |
| Language | DE/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 | |
| | 1. Methoden der statistischen Inferenz, Likelihood und Bayes, Held, L., Spektrum 2008 |
| | Stochastik f ür Informatiker, D ümbgen, L., Springer 2003 Stotistik Dan Wassers Datasashus, Schemelin L, K ünstland D, Dissett L, Tute, C., Springer 2010 |
| | 3. Statistik: Der Weg zur Datenanalyse, Fahrmeir, L., Künstler R., Pigeot, I, Tutz, G., Springer 2010 |
| | Stochastik, Georgii, HO., deGruyter, 2009 Brobability and Pandom Processor, Grimmett, G., Stirzakor, D., Oxford University Processor, 2001 |
| | Probability and Random Processes, Grimmett, G., Stirzaker, D., Oxford University Press, 2001 Programmieren mit R, Ligges, U., Springer 2008 |
| | o. rrogrammeren mir n, Ligges, o., Springer 2000 |

| Course L0778: Stochastics | |
|---------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Christian Seifert |
| Language | DE/EN |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Courses | | | | |
|--|---|--|--------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Automata Theory and Formal Lang | | Lecture | 2 | 4 |
| Automata Theory and Formal Lang | | Recitation Section (small) | 2 | 2 |
| Module Responsible | | | | |
| Admission Requirements | | | | |
| | Participating students should be able to | | | |
| Knowledge | - specify algorithms for simple data struct | tures (such as, e.g., arrays) to solve computational | problems | |
| | apply propositional lagis and produces. | lania fay ana situ ing and understanding mathematic | al avaafa | |
| | - apply propositional logic and predicate i | logic for specifying and understanding mathematic | ai proois | |
| | - apply the knowledge and skills taught in | n the module Discrete Algebraic Structures | | |
| Educational Objectives | After taking part successfully, students h | ave reached the following learning results | | |
| Professional Competence | | 5 5 | | |
| - | Students can explain syntax, semantics | , and decision problems of propositional logic, an | d they are able to | o give algorithms |
| | | n show correspondences to Boolean algebra. Stu | - | |
| | | ropositional logic, and therefore, the students car | | |
| | | ns for this representation formalism. Students car | | - |
| | | problem. Students can also describe syntax, semar | | |
| | | heir application areas. The participants of the cou | | |
| | | s to logic and formal grammars. The spectrum t | | |
| | | | | |
| | | e automata and pushdown automata to Turing more expressive than determinism. They are als | | |
| | | d, in addition, students can transform decision prob | | |
| | | nderstand that some formalisms easily induce algo | | |
| | | ies. Students can describe the relationships betwee | | |
| | or grammars. | es. stadents can desense the relationships betwee | | i us iogic, uutoin |
| | or granmars. | | | |
| | | | | |
| | | | | |
| Skills | Students can apply propositional logic as | well as predicate logic resolution to a given set of | formulas Student | s analyze annlicat |
| | | Il logic, predicate logic, or temporal logic formulas | | |
| | | rticular application problem, and they can demons | | - |
| | | Students can also transform nondeterministic auto | | - |
| | | sa. They can show how parsers work, and they o | | |
| | emptiness problem in case of infinite wor | | 11 5 | 5 |
| | | | | |
| Personal Competence Social Competence | | | | |
| Autonomy | | | | |
| Workload in Hours | Independent Study Time 124, Study Time | e in Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| | 5 5 . 1 | ogram, 7 semester): Specialisation Computer Scien | | ulsory |
| Following Curricula | | ogram, 7 semester): Specialisation Computer Scien | ce. compulsory | |
| | Computer Science: Core Qualification: Co | | | |
| | Data Science: Core Qualification: Comput | • | | |
| | Engineering Science: Specialisation Mech | | en Flastive Corr | Jaam |
| | | ogram, 7 semester): Specialisation Computer Science | | - |
| | General Engineering Science (English pro | ogram, 7 semester): Specialisation Mechatronics: El | ective Compulsory | |
| | Comparison of Colors Inc. 1 | Come Overlife and a Comment | | |
| | Computational Science and Engineering: Orientierungsstudium: Core Qualification: | | | |

| Тур Hrs/wk | Lecture |
|-------------------|--|
| Hrs/wk | |
| 111 <i>5/</i> WR | 2 |
| CP | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. Tobias Knopp |
| Language | EN |
| 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: |
| | Mynni-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 automaton principally cannot be expressiv |
| | 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, pumpir |
| | lemma for context-free grammars, transformation of formalisms (from pushdown automata to context-free grammars ar |
| | back) |
| | 12. Chomsky normal form |
| | 13. CYK algorithm for deciding the word problem for context-free grammrs |
| | 14. Deterministic pushdown automata |
| | 15. Deterministic 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. LTL safety conditions and model checking with Büchi automata, relationships between automata and logic |
| | 22. Fixed points, propositional mu-calculus |
| | 23. Characterization of regular languages by monadic second-order logic (MSO) |
| Literature | |
| Literature | 1. Logik für Informatiker Uwe Schöning, Spektrum, 5. Aufl. |
| | 2. Logik für Informatiker Martin Kreuzer, Stefan Kühling, Pearson Studium, 2006 |
| | 3. Grundkurs Theoretische Informatik, Gottfried Vossen, Kurt-Ulrich Witt, Vieweg-Verlag, 2010. |
| | 4. Principles of Model Checking, Christel Baier, Joost-Pieter Katoen, The MIT Press, 2007 |
| | |

| Course L0507: Automata The | ourse L0507: Automata Theory and Formal Languages | | |
|----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| CP | 2 | | |
| Workload in Hours | dependent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | f. Tobias Knopp | | |
| Language | EN | | |
| Cycle | SoSe | | |
| Content | e interlocking course | | |
| Literature | See interlocking course | | |

| dded Systems | | | | |
|--|--|--|--|--|
| | | | | |
| | Тур | Hrs/wk | СР | |
| | Lecture | 3 | 4 | |
| | Recitation Section (small) | 1 | 2 | |
| Prof. Heiko Falk | | | | |
| None | | | | |
| Computer Engineering | | | | |
| | | | | |
| After taking part successfully, students have | reached the following learning results | | | |
| | | | | |
| foundations of such systems. In particular, it their specification languages (models of cor | deals with an introduction into these system mputation, hierarchical automata, specification | s (notions, commor | n characteristics) a | |
| hardware, embedded processors, memories, introduction into real-time operating system systems using hardware/software co-design | , energy dissipation, reconfigurable logic and ns, middleware and real-time scheduling. Fin (hardware/software partitioning, high-level tr | actuators. The council ally, the implement | urse also features ntation of embedd | |
| After having attended the course, students shall be able to realize simple embedded systems. The students shall realize whi relevant parts of technological competences to use in order to obtain a functional embedded systems. In particular, they shall able to compare different models of computations and feasible techniques for system-level design. They shall be able to judge which areas of embedded system design specific risks exist. | | | | |
| | | | | |
| Students are able to solve similar problems a | lone or in a group and to present the results a | ccordingly. | | |
| Students are able to acquire new knowledge | from specific literature and to associate this k | nowledge with othe | er classes. | |
| Independent Study Time 124, Study Time in I | Lecture 56 | | | |
| 6 | | | | |
| Compulsory Bonus Form | Description | | | |
| , | and | | | |
| | | | | |
| | | | | |
| 90 minutes, contents of course and labs | | | | |
| Conoral Engineering Science (Cormon progra | 7 competerly Specialization Computer Scie | nco: Elective Comp | ulcon | |
| | | | uisory | |
| | | | | |
| | | - | | |
| | | | | |
| Engineering Science: Specialisation Mechatro | nics: Elective Compulsory | | | |
| Aircraft Systems Engineering: Specialisation / | Avionic Systems: Elective Compulsory | | | |
| General Engineering Science (English program | n, 7 semester): Specialisation Computer Scier | nce: Elective Compu | ulsory | |
| General Engineering Science (English program | n, 7 semester): Specialisation Mechatronics: E | lective Compulsory | 1 | |
| Computational Science and Engineering: Core | e Qualification: Compulsory | | | |
| Mechatronics: Specialisation System Design: | Elective Compulsory | | | |
| | | | | |
| Microelectronics and Microsystems: Specialisa | ation Embedded Systems: Elective Compulsor | У | | |
| | | | | |
| stems | | | | |
| | | | | |
| Lecture | | | | |
| 3 | | | | |
| 3 4 | | | | |
| 3 4 Independent Study Time 78, Study Time in Le | ecture 42 | | | |
| 3 4 Independent Study Time 78, Study Time in Le Prof. Heiko Falk | ecture 42 | | | |
| 3 4 Independent Study Time 78, Study Time in Le | ecture 42 | | | |
| 3 4 Independent Study Time 78, Study Time in Le Prof. Heiko Falk | ecture 42 | | | |
| 3 4 Independent Study Time 78, Study Time in Le Prof. Heiko Falk EN | ecture 42 | | | |
| | None Computer Engineering After taking part successfully, students have Embedded systems can be defined as inform foundations of such systems. In particular, it their specification languages (models of conspecification of real-time applications, translat Another part covers the hardware of embe hardware, embedded processors, memories, introduction into real-time operating system systems using hardware/software co-design efficient realizations, compilers for embedded After having attended the course, students relevant parts of technological competences able to compare different models of compute which areas of embedded system design specture Students are able to solve similar problems a Students are able to acquire new knowledge Independent Study Time 124, Study Time in I 6 Compulsory Bonus Form Yes 10 % Subject theoretical practical work Written exam 90 minutes, contents of course and labs General Engineering Science (German progra General Engineering Science (German progra Computer Science: Specialisation Computer ac Computer Science: Specialisation I. Computer Electrical Engineering Science (English prograr General Engineering: Core Qualification: Ele Engine | Typ Lecture Recitation Section (small) Prof. Heiko Falk None Computer Engineering After taking part successfully, students have reached the following learning results Embedded systems can be defined as information processing systems embedded into enc foundations of such systems. In particular, it deals with an introduction into these system their specification languages (models of computation, hierarchical automata, specificati specification of real-time applications, translations between different models). Another part covers the hardware of embedded systems: Sonsors, A/D and D/A conve hardware, embedded processors, memories, energy dissipation, reconfigurable logic and introduction into real-time operating systems, middleware and real-time scheduling. Fir systems using hardware/software co-design (hardware/software partitioning, high-level tr efficient realizations, compilers for embedded processors) is covered. After having attended the course, students shall be able to realize simple embedded sy relevant parts of technological competences to use in order to obtain a functional embed able to compare different models of computations and feasible techniques for system-lev which areas of embedded system design specific risks exist. Students are able to acquire new knowledge from specific literature and to associate this k Independent Study Time 124, Study Time in Lecture 56 6 Computery Bonus Form Description Yes 10 % Subject theoretical and practical work Written exam 90 minutes, contents of course and labs General Engineering Science (German program, 7 | Typ Hrs/wk Lecture 3 Recitation Section (small) 1 Prof. Heiko Falk None Computer Engineering After taking part successfully, students have reached the following learning results Embedded systems can be defined as information processing systems embedded into enclosing products. Th foundations of such systems. In particular, it deals with an introduction into these systems (notions, commor their specification of real-time applications, translations between different models). Another part covers the hardware of embedded systems: Sonsors, A/D and D/A converters, real-time cap hardware, embedded processors, memories, energy dissipation, reconfigurable logic and actuators. The countrol transformations of specification of real-time operating systems, middleware partitioning, high-level transformations of specificent realizations, compilers for embedded processors) is covered. After having attended the course, students shall be able to realize simple embedded systems. In parable to compare different models of computations and feasible techniques for system-level design. They sha which areas of embedded system design specific risks exist. Students are able to solve similar problems alone or in a group and to present the results accordingly. Students are able to acquire new knowledge from specific literature and to associate this knowledge with other independent Study Time 124, Study Time in Lecture 56 6 Computery It | |

 • 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. 2 nd Edition, Springer, 2012.

| Course L0806: Embedded Sy | purse L0806: Embedded Systems | | |
|---------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 1 | | |
| CP | 2 | | |
| Workload in Hours | dependent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | f. Heiko Falk | | |
| Language | | | |
| Cycle | oSe | | |
| Content | ee interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | |
|---|--|---|-------------------|---------------------|
| | | | | |
| Fitle Objectoriented Programming, Algor | ithms and Data Structures (10131) | Typ Lecture | Hrs/wk 4 | CP 4 |
| Objectoriented Programming, Algor | | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Rolf-Rainer Grigat | | | |
| - | None | | | |
| - | This lecture requires proficiency in the German | n language. For further requirements please re | fer to the Germar | description. |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have re | eached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students can explain the essentials of softw libraries and design patterns. | are design and the design of a class archited | cture with refere | nce to existing cla |
| | Students can describe fundamental data struc sorting and searching. | tures of discrete mathematics and assess the | complexity of imp | oortant algorithms |
| Skills | Students are able to | | | |
| | | terns and applying class hierarchies and polym sts using version management systems and Go | | |
| Personal Competence | | | | |
| - | Students can work in teams and communicate | in forums. | | |
| Autonomy | Students are able to solve programming tasks such as LZW data compression using SVN Repository and Google Test independe and over a period of two to three weeks. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lo | ecture 70 | | |
| | 6 | | | |
| | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 60 Minutes, Content of Lecture, exercises and | material in StudIP | | |
| Assignment for the | General Engineering Science (German program | n, 7 semester): Specialisation Computer Science | ce: Elective Comp | ulsory |
| Following Curricula | Electrical Engineering: Core Qualification: Corr | pulsory | | |
| | | , 7 semester): Specialisation Computer Science | e: Compulsory | |
| | Logistics and Mobility: Specialisation Engineer | ing Science: Elective Compulsory | | |

| Course L0131: Objectoriente | d Programming, Algorithms and Data Structures | | |
|-----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | | | |
| CP | | | |
| 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 | | |

| ourse L0132: Objectoriented Programming, Algorithms and Data Structures | | |
|---|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| CP | 2 | |
| Workload in Hours | dependent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | f. Rolf-Rainer Grigat | |
| Language | | |
| Cycle | Se | |
| Content | ee interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | | | |
|--------------------------------|--|--------------------|-------------------------|--------------------------------------|-------------------|--------------------|
| Title | | | | Тур | Hrs/wk | СР |
| Functional Programming (L0624) | | | | Lecture | 2 | 2 |
| Functional Programming (L0625) | | | | Recitation Section (large) | 2 | 2 |
| Functional Programming (L0626) | | | | Recitation Section (small) | 2 | 2 |
| | Prof. Sibylle Schupp | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Discrete mathematio | cs at high-school | level | | | |
| Knowledge | | | | | | |
| Educational Objectives | After taking part suc | cessfully, studer | nts have reached the | following learning results | | |
| Professional Competence | | | | | | |
| Knowledge | Students apply the principles, constructs, and simple design techniques of functional programming. They demonstrate their abili to read Haskell programs and to explain Haskell syntax as well as Haskell's read-eval-print loop. They interpret warnings and fir 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 an implementations level, and justify their choice. They analyze given programs and rewrite them in a controlled way. They desig 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 poprograms orally. The | | | . They explain problems and solut | ions to their pee | r. They defend the |
| 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 1 | Time 96, Study T | ime in Lecture 84 | | | |
| Credit points | 6 | | | | | |
| Course achievement | Compulsory Bonus | Form | Descrip | tion | | |
| | Yes 15 % | Excercises | | | | |
| Examination | Written exam | | | | | |
| Examination duration and | 90 min | | | | | |
| scale | | | | | | |
| Assignment for the | General Engineering | Science (Germa | n program, 7 semest | er): Specialisation Computer Science | e: Elective Comp | ulsory |
| Following Curricula | Computer Science: 0 | Core Qualification | n: Compulsory | | | |
| | Data Science: Core (| Qualification: Ele | ctive Compulsory | | | |
| | Engineering Science | : Specialisation I | Mechatronics: Elective | Compulsory | | |
| | General Engineering | Science (English | n program, 7 semeste | r): Specialisation Computer Science | e: Elective Compu | llsory |
| | General Engineering | Science (English | n program, 7 semeste | r): Specialisation Mechatronics: Ele | ctive Compulsory | |
| | Computational Scien | co and Enginoor | ing: Specialization L (| Computer Science: Elective Compu | con/ | |
| | computational Scien | ice and Engineer | ing. specialisation i. | computer science. Elective Compu | SOLA | |

| Course L0624: Functional Programming | | | |
|--------------------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | | | |
| CP | 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: Functional Programming | | |
|--------------------------------------|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| CP | 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 Programming Idioms of Functional Programming Haskell Syntax and Semantics | |
| Literature | Graham Hutton, Programming in Haskell, Cambridge University Press 2007. | |

| T | Desidering Conting (appell) |
|-------------------|---|
| | Recitation Section (small) |
| Hrs/wk | 2 |
| CP | 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. |

| Courses | | | | |
|---------------------------------|--|---|--------------------------|------|
| Title | | Тур | Hrs/wk | СР |
| ntroductory Seminar Computer Sc | ence I (L2362) | Seminar | 2 | 3 |
| ntroductory Seminar Computer Sc | ence II (L2361) | Seminar | 2 | 3 |
| Module Responsible | Prof. Karl-Heinz Zimmermann | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge of Computer Science and | Mathematics at the Bachelor's level. | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have | ve reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are able to | | | |
| | | | | |
| | explicate a specific topic in the field | of Computer Science, | | |
| | describe complex issues, | | | |
| | present different views and evaluate | e în a critical way. | | |
| Skills | The students are able to | | | |
| | for the size is a second in the size of Course | auton Calanaa in Kasikad kina | | |
| | familiarize in a specific topic of Com | | | |
| | realize a literature survey on the sp | | | |
| | elaborate a presentation and give a | | | |
| | sum up the presentation in 10-15 lin answer questions in the final discussion | | | |
| | answer questions in the final discuss | SIOT. | | |
| Personal Competence | | | | |
| Social Competence | The students are able to | | | |
| | elaborate and introduce a topic for a | a cortain audionco | | |
| | | ture of the presentation with the instructor, | | |
| | discuss certain aspects with the auc | | | |
| | as the lecturer listen and respond to | | | |
| | | | | |
| Autonomy | The students are able to | | | |
| | define the task in question in an aut | conomous way. | | |
| | develop the necessary knowledge, | , | | |
| | use appropriate work equipment, ar | nd | | |
| | guided by an instructor critically che | | | |
| | | | | |
| | Independent Study Time 124, Study Time | IN Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Presentation | | | |
| Examination duration and | x | | | |
| scale | | | | |
| Assignment for the | | gram, 7 semester): Specialisation Computer S | cience: Elective Compuls | sory |
| Following Curricula | | | | |
| | | ram, 7 semester): Specialisation Computer Se | cience: Elective Compuls | ory |
| | Computational Science and Engineering: C | ore Qualification: Compulsory | | |

| Course L2362: Introductory | Course L2362: Introductory Seminar Computer Science I | |
|----------------------------|---|--|
| Тур | Seminar | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | pendent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | . Karl-Heinz Zimmermann | |
| Language | EN | |
| Cycle | Se/SoSe | |
| Content | | |
| Literature | | |

| Course L2361: Introductory Seminar Computer Science II | | |
|--|---|--|
| Тур | minar | |
| Hrs/wk | | |
| CP | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Karl-Heinz Zimmermann | |
| Language | DE/EN | |
| Cycle | WiSe/SoSe | |
| Content | | |
| Literature | | |

| Module M0834: Comp | uternetworks and Internet S | Security | | |
|----------------------------------|---|--|-----------------------|----------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Computer Networks and Internet S | | Lecture | 3 | 5 |
| Computer Networks and Internet S | | Recitation Section (small) | 1 | 1 |
| Module Responsible | Prof. Andreas Timm-Giel | | | |
| Admission Requirements | None | | | |
| | Basics of Computer Science | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students h | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to explain important a | and common Internet protocols in detail and clas | sify them, in order t | to be able to analys |
| | and develop networked systems in furthe | er studies and job. | | |
| Skille | Students are able to analyse common Internet protocols and evaluate the use of them in different domains. | | | |
| JKIIIS | Students are able to analyse common inc | | interent domains. | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | Students can select relevant parts out of | high amount of professional knowledge and can | independently learn | and understand it. |
| Workload in Hours | Independent Study Time 124, Study Time | e in Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German pr | ogram, 7 semester): Specialisation Computer Sci | ence: Elective Comp | ulsory |
| Following Curricula | Computer Science: Core Qualification: Co | ompulsory | | |
| | Data Science: Core Qualification: Elective | e Compulsory | | |
| | Electrical Engineering: Core Qualification: | : Elective Compulsory | | |
| | Engineering Science: Specialisation Mech | | | |
| | General Engineering Science (English pro | ogram, 7 semester): Specialisation Computer Scie | nce: Elective Compu | ulsory |
| | General Engineering Science (English pro | ogram, 7 semester): Specialisation Mechatronics: | Elective Compulsory | / |
| | Computational Science and Engineering: | Core Qualification: Compulsory | | |
| | Technomathematics: Specialisation II. Inf | ormatics: Elective Compulsory | | |

| Course L1098: Computer Net | tworks and Internet Security |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 5 |
| Workload in Hours | Independent Study Time 108, Study Time in Lecture 42 |
| Lecturer | Prof. Andreas Timm-Giel, Prof. Dieter Gollmann, DrIng. Koojana Kuladinithi |
| 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 |
| Literature | Internet security: IPSec Internet security: Firewalls |
| | 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 Net | ourse L1099: Computer Networks and Internet Security | | |
|----------------------------|--|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 1 | | |
| CP | 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 | | |

| Courses | | | | |
|---------------------------------|--|---|---|--|
| Title | | Тур | Hrs/wk | СР |
| Numerical Mathematics I (L0417) | | Lecture | 2 | 3 |
| Numerical Mathematics I (L0418) | | Recitation Section (small) | 2 | 3 |
| Module Responsible | Prof. Sabine Le Borne | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mathematik I + II for Engineering Students (germain | n or english) or Analysis & Linear Alg | rebra I + II for Te | chnomathematic |
| Knowledge | basic MATLAB/Python knowledge | r er englisht, er randijshs a Einear rag | , | |
| | | | | |
| | After taking part successfully, students have reached the | following learning results | | |
| Professional Competence | Chudauta ana abla ta | | | |
| Knowleage | Students are able to | | | |
| | name numerical methods for interpolation, integra | tion, least squares problems, eigenv | value problems, r | ionlinear root fin |
| | problems and to explain their core ideas, | | | |
| | repeat convergence statements for the numerical r | | | |
| | explain aspects for the practical execution of nume | rical methods with respect to comp | utational and stor | age complexitx. |
| | | | | |
| | | | | |
| Skills | Students are able to | | | |
| | implement, apply and compare numerical methods | using MATLAB/Python, | | |
| | justify the convergence behaviour of numerical me | thods with respect to the problem a | nd solution algori | thm, |
| | select and execute a suitable solution approach for | a given problem. | | |
| Personal Competence | | | | |
| • | Students are able to | | | |
| Social competence | | | | |
| | work together in heterogeneously composed team | s (i.e., teams from different study pr | ograms and bac | kground knowled |
| | explain theoretical foundations and support each o | ther with practical aspects regarding | g the implementa | tion of algorithm |
| Autonomv | Students are capable | | | |
| , | | | | |
| | to assess whether the supporting theoretical and p | | 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 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 minutes | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 semest | er): Specialisation Computer Science | e: Compulsory | |
| Following Curricula | General Engineering Science (German program, 7 s | emester): Specialisation Mechanic | al Engineering, | Focus Material |
| | Engineering Sciences: Compulsory | | | |
| | General Engineering Science (German program, 7 semest | | | |
| | General Engineering Science (German program, 7 se | mester): Specialisation Mechanica | I Engineering, F | ocus Biomechai |
| | Compulsory General Engineering Science (German program, 7 semes | er): Specialisation Mechanical Engir | eering Focus Th | eoretical Mecha |
| | Engineering: Compulsory | , specialisation meenumeur Eligii | | Longeneration meeting |
| | General Engineering Science (German program, 7 sen | ester): Specialisation Mechanical | Engineerina. Foo | us Aircraft Svst |
| | Engineering: Elective Compulsory | | 5 . 5, 00 | |
| | General Engineering Science (German program, 7 semes | ter): Specialisation Mechanical Engi | neering, Focus M | echatronics: Elec |
| | Compulsory | . 5 | - | |
| | General Engineering Science (German program, 7 sem | ester): Specialisation Mechanical I | Engineering, Foc | |
| | | estery. specialisation mechanical i | | us Energy Syste |
| | Elective Compulsory | estery. Specialisation mechanical i | | us Energy Syste |
| | | | iry | us Energy Syste |
| | Elective Compulsory | cess Engineering: Elective Compulso | pry | us energy syste |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng | cess Engineering: Elective Compulso atics: Elective Compulsory | | us Energy Syste |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory | tess Engineering: Elective Compulso atics: Elective Compulsory ineering Science: Elective Compulso | | us energy syste |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compu | tess Engineering: Elective Compulso atics: Elective Compulsory ineering Science: Elective Compulso | | us energy syste |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compu Engineering Science: Core Qualification: Compulsory | tess Engineering: Elective Compulso atics: Elective Compulsory ineering Science: Elective Compulso | | us energy syste |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compu Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory | cess Engineering: Elective Compulso atics: Elective Compulsory ineering Science: Elective Compulso Isory | | us Energy Syste |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compu Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester | ess Engineering: Elective Compulso atics: Elective Compulsory ineering Science: Elective Compulso lsory r): Core Qualification: Compulsory | bry | us Energy Syste |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compu Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester | ess Engineering: Elective Compulso atics: Elective Compulsory ineering Science: Elective Compulso lsory r): Core Qualification: Compulsory r): Specialisation Computer Science | ry : Compulsory | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compu Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester | ess Engineering: Elective Compulso atics: Elective Compulsory ineering Science: Elective Compulso lsory r): Core Qualification: Compulsory r): Specialisation Computer Science | ry : Compulsory | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compul Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester Compulsory | eess Engineering: Elective Compulse atics: Elective Compulsory ineering Science: Elective Compulse lsory r): Core Qualification: Compulsory r): Specialisation Computer Science mester): Specialisation Mechanical | : Compulsory Engineering, F | ocus Biomechai |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compul Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester Compulsory General Engineering Science (English program, 7 semester Compulsory General Engineering Science (English program, 7 semester | eess Engineering: Elective Compulse atics: Elective Compulsory ineering Science: Elective Compulse lsory r): Core Qualification: Compulsory r): Specialisation Computer Science mester): Specialisation Mechanical | : Compulsory Engineering, F | ocus Biomechai |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compul Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester Compulsory | eess Engineering: Elective Compulse atics: Elective Compulsory ineering Science: Elective Compulse lsory r): Core Qualification: Compulsory r): Specialisation Computer Science mester): Specialisation Mechanical er): Specialisation Mechanical Engine | : Compulsory Engineering, F eering, Focus Mat | ocus Biomechai erials in Enginee |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compul Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester Compulsory General Engineering Science (English program, 7 semester Sciences: Compulsory | eess Engineering: Elective Compulse atics: Elective Compulsory ineering Science: Elective Compulse lsory r): Core Qualification: Compulsory r): Specialisation Computer Science mester): Specialisation Mechanical er): Specialisation Mechanical Engine | : Compulsory Engineering, F eering, Focus Mat | ocus Biomechai erials in Enginee |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compul Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester Compulsory General Engineering Science (English program, 7 semester Sciences: Compulsory General Engineering Science (English program, 7 semester Sciences: Compulsory General Engineering Science (English program, 7 semester Sciences: Compulsory | eess Engineering: Elective Compulse atics: Elective Compulsory ineering Science: Elective Compulse lsory r): Core Qualification: Compulsory r): Specialisation Computer Science mester): Specialisation Mechanical er): Specialisation Mechanical Engine | : Compulsory ⊢ Engineering, F eering, Focus Mat eering, Focus Th | ocus Biomechai erials in Enginee eoretical Mechai |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biopro Computer Science: Specialisation Computational Mathem Computer Science: Specialisation II. Mathematics and Eng Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compul Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester Sciences: Compulsory General Engineering Science (English program, 7 semester Sciences: Compulsory | eess Engineering: Elective Compulse atics: Elective Compulsory ineering Science: Elective Compulse lsory r): Core Qualification: Compulsory r): Specialisation Computer Science mester): Specialisation Mechanical er): Specialisation Mechanical Engine r): Specialisation Mechanical Engine | : Compulsory Engineering, F eering, Focus Mat eering, Focus Th eering: Compulso | ocus Biomechai erials in Enginee eoretical Mechai Ƴ |

Computational Science and Engineering: Core Qualification: Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Mechanical Engineering: Specialisation Mechatronics: Elective Compulsory

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

Process Engineering: Specialisation Process Engineering: Elective Compulsory

| Course L0417: Numerical Ma | thematics I | | | |
|----------------------------|--|--|--|--|
| Тур | Lecture | | | |
| Hrs/wk | | | | |
| CP | | | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | | |
| Lecturer | Prof. Sabine Le Borne | | | |
| Language | EN | | | |
| Cycle | WiSe | | | |
| Content | Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss quadrature, adaptive quadrature | | | |
| Literature | Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer | | | |

| Course L0418: Numerical Ma | urse L0418: Numerical Mathematics I | | |
|----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| CP | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Sabine Le Borne, Dr. Jens-Peter Zemke | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | | | |
|-------------------------------|---|------------------|-----------------------------|----------------------------|-----------------|-----------------------|
| Fitle | | | Тур | | Hrs/wk | СР |
| Computer Architecture (L0793) | | | Lecture | | 2 | 3 |
| Computer Architecture (L0794) | | | Project-/ | problem-based Learning | 2 | 2 |
| Computer Architecture (L1864) | | | Recitatio | on Section (small) | 1 | 1 |
| Module Responsible | Prof. Heiko Falk | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Module "Computer Engineering" | | | | | |
| Knowledge | | | | | | |
| Educational Objectives | After taking part successfully, st | udents have re | ached the following learni | ng results | | |
| Professional Competence | | | | | | |
| Knowledge | This module presents advanced | l concepts from | n the discipline of comput | ter architecture. In the | beginning, a l | broad overview ov |
| | various programming models | is given, both | for general-purpose cor | nputers and for specia | Il-purpose ma | achines (e.g., sigi |
| | processors). Next, foundational | aspects of the i | micro-architecture of proc | essors are covered. Here | e, the focus pa | articularly lies on t |
| | so-called pipelining and the me | thods used for | the acceleration of instru | ction execution used in | this context. | The students get |
| | know concepts for dynamic s | cheduling, brai | nch prediction, supersca | lar execution of machi | ne instruction | ns and for memo |
| | hierarchies. | | | | | |
| | | | | | | |
| Skills | The students are able to describ | - | | | | |
| | models. The students examine | | | | | |
| | analyze them w.r.t. criteria like, e.g., performance or energy efficiency. They evaluate different structures of memory h | | | | - | |
| | know parallel computer archited | tures and are a | ble to distinguish betweer | n instruction- and data-le | evel parallelis | m. |
| Personal Competence | | | | | | |
| Social Competence | Students are able to solve simila | ar problems alo | ne or in a group and to pro | esent the results accordi | ngly. | |
| Autonomy | Students are able to acquire new | u knowlodgo fr | m chacific literature and | to accoriate this knowle | dae with othe | r classes |
| Autonomy | Students are able to acquire her | w knowledge no | she specific literature and | | uge with othe | r classes. |
| Workload in Hours | Independent Study Time 110, S | tudy Time in Le | cture 70 | | | |
| Credit points | 6 | | | | | |
| Course achievement | Compulsory Bonus Form | | Description | | | |
| | | | and | | | |
| | practical | work | | | | |
| Examination | Written exam | | | | | |
| Examination duration and | 90 minutes, contents of course | and 4 attestatio | ns from the PBL "Compute | er architecture" | | |
| scale | | | | | | |
| Assignment for the | General Engineering Science (G | erman program | , 7 semester): Specialisati | on Computer Science: E | lective Compu | ulsory |
| Following Curricula | Computer Science: Specialisatio | n Computer an | d Software Engineering: E | lective Compulsory | | |
| | Computer Science: Specialisatio | n I. Computer a | nd Software Engineering: | Elective Compulsory | | |
| | Aircraft Systems Engineering: C | ore Qualificatio | n: Elective Compulsory | | | |
| | Aircraft Systems Engineering: S | pecialisation Av | ionic Systems: Elective Co | ompulsory | | |
| | General Engineering Science (Er | nglish program, | 7 semester): Specialisatio | on Computer Science: El | ective Compu | lsory |
| | Computational Science and Eng | ineering: Specia | alisation I. Computer Scier | ice: Elective Compulsory | , | |
| | | | | | | |

| Course L0793: Computer Arc | hitecture |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 |
| CP | 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 |
| CP | 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 | | | | | | | |
|----------------------------------|---|--|----------------------|--------------------|--|--|--|
| Title | | Тур | Hrs/wk | СР | | | |
| Computability and Complexity The | | Lecture | 2 | 3 | | | |
| Computability and Complexity The | | Recitation Section (small) | 2 | 3 | | | |
| Module Responsible | Prof. Karl-Heinz Zimmermann | | | | | | |
| Admission Requirements | None | | | | | | |
| Recommended Previous | Discrete Algebraic Structures, Automata | a Theory, Logic, and Formal Language Theory. | | | | | |
| Knowledge | | | | | | | |
| Educational Objectives | After taking part successfully, students | have reached the following learning results | | | | | |
| Professional Competence | | | | | | | |
| Knowledge | The students known the important machine models of computability, the class of partial recursive functions, univer computability, Gödel numbering of computations, the theorems of Kleene, Rice, and Rice-Shapiro, the concept of decidable a undecidable sets, the word problems for semi-Thue systems, Thue systems, semi-groups, and Post correspondence system 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 | Students are able to solve specific prob | lems alone or in a group and to present the result | s accordingly. | | | | |
| Autonomy | Students are able to acquire new knowl | edge from newer literature and to associate the a | acquired knowledge w | ith other classes. | | | |
| Workload in Hours | Independent Study Time 124, Study Tin | ne in Lecture 56 | | | | | |
| Credit points | 6 | | | | | | |
| Course achievement | None | | | | | | |
| Examination | Written exam | | | | | | |
| Examination duration and | 60 min | | | | | | |
| scale | | | | | | | |
| Assignment for the | General Engineering Science (German g | program, 7 semester): Specialisation Computer Sc | ience: Elective Comp | ulsory | | | |
| Following Curricula | Computer Science: Core Qualification: C | Compulsory | | , | | | |
| | Data Science: Core Qualification: Elective Compulsory | | | | | | |
| | General Engineering Science (English pi | rogram, 7 semester): Specialisation Computer Sci | ence: Elective Compu | ulsory | | | |
| | Computational Science and Engineering: Specialisation I. Computer Science: Elective Compulsory | | | | | | |
| | Technomathematics: Specialisation II. Ir | | | | | | |

| Course L0166: Computability | and Complexity Theory |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 | |

| Course L0167: Computability | / and Complexity Theory |
|-----------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| CP | 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 M0971: Opera | iting 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 | | was and data structures | | |
| Knowledge | Object-oriented programming, algorith | ims, and data structures | | |
| | Procedural programming Evenerics in using tools related to an | ersting systems such as editors, linkars, sometil | | |
| | | erating systems such as editors, linkers, compile | ers | |
| | Experience in using C-libraries | | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students explain the main abstractions proc | ess, virtual memory, deadlock, lifelock, and fil | e of operations sy | ystems, describe th |
| | process states and their transitions, and p | araphrase the architectural variants of operat | ing systems. The | ey give examples d |
| | existing operating systems and explain their | architectures. The participants of the course wr | ite concurrent pro | grams using thread |
| | conditional variables and semaphores. Stude | nts can describe the variants of realizing a file s | ystem. Students e | explain at least thre |
| | different scheduling algorithms. | | | |
| Skille | Students are able to use the POSIX libraries t | for concurrent programming in a correct and eff | icient way They a | are able to judge the |
| SKIIS | efficiency of a scheduling algorithm for a give | 1 5 5 | iciciic way. They c | are usic to judge the |
| | | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | | | | |
| Workload in Hours | Independent Study Time 124, Study Time in I | Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German progra | m, 7 semester): Specialisation Computer Science | e: Elective Comp | ulsory |
| Following Curricula | Computer Science: Specialisation I. Computer | r and Software Engineering: Elective Compulsor | у | |
| | General Engineering Science (English program | n, 7 semester): Specialisation Computer Science | e: Elective Compu | llsory |
| | Computational Science and Engineering: Spe | cialisation I. Computer Science: Elective Compu | lsory | |
| | Technomathematics: Specialisation II. Inform | atics: Elective Compulsory | | |

| Course L1153: Operating Sys | stems | | |
|-----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| CP | 3 | | |
| Workload in Hours | ndent 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 Sys | stems |
|-----------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| CP | 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 | | | | | | |
|--|--|------------------------------|--|---------------------|--------------------|--|
| ſitle | | | 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 | • Automata theory an | formal languages | | | | |
| Knowledge | Automata theory an Brocodural program | ning or Functional program | mina | | | |
| | | amming, algorithms, and | | | | |
| | Object-offented prog | annining, algorithnis, and | | | | |
| Educational Objectives | After taking part successfu | y, students have reached | the following learning results | | | |
| Professional Competence | | | | | | |
| Knowledge | Students explain the pha | ses of the software life | cycle, describe the fundamental ter | minology and co | oncepts of softwa | |
| | engineering, and paraphra | e the principles of structur | ed software development. They give ex | amples of softwa | re-engineering tas | |
| | of existing large-scale sys | ems. They write test cas | es for different test strategies and d | evise specificatio | ns or models usi | |
| different notations, and critique both. They explain simple design patterns and the major activities | | | | r activities in ree | quirements analys | |
| | maintenance, and project planning. | | | | | |
| Skills | For a given task in the se | twara lifa cycla, studants | identify the corresponding phase and | coloct an appro | oristo mothod Th | |
| 34///3 | s For a given task in the software life cycle, students identify the corresponding phase and select an appropriate method. The choose the proper approach for quality assurance. They design tests for realistic systems, assess the quality of the tests, and fir | | | | | |
| errors at different levels. They apply and modify non-executable artifacts. They integrate components based of | | | | | | |
| | specifications. | | | | | |
| | specificationsi | | | | | |
| Personal Competence | | | | | | |
| Social Competence | Students practice peer pro | ramming. They explain pr | oblems and solutions to their peer. They | / communicate in | English. | |
| Autonomy | Using on-line guizzes and | accompanying material fo | self study, students can assess their | level of knowled | ge continuously a | |
| Autonomy | | | , they receive additional feedback. | | ge continuously a | |
| | | | ,, | | | |
| Workload in Hours | Independent Study Time 1 | 4, Study Time in Lecture 5 | 6 | | | |
| | 6 | | | | | |
| Course achievement | | | scription | | | |
| | | rcises | | | | |
| | Written exam | | | | | |
| | 90 min | | | | | |
| scale | | | | | | |
| - | | | nester): Specialisation Computer Scienc | e: Elective Comp | ulsory | |
| Following Curricula | Computer Science: Core Qu | | | | | |
| | | | ester): Specialisation Computer Science | | lsory | |
| | Computational Science and Engineering: Specialisation I. Computer Science: Elective Compulsory Technomathematics: Specialisation II. Informatics: Elective Compulsory | | | | | |

| Course L0627: Software Eng | ineering |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | 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 Eng | ineering |
|----------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| CP | 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 |

| Courses | | | | | | | |
|-----------------------------------|--|--------------|------------------|---------------------|--|--|--|
| Title | Тур | | Hrs/wk | СР | | | |
| Lab Cyber-Physical Systems (L174) | | d Learning | 4 | 6 | | | |
| Module Responsible | Prof. Heiko Falk | | | | | | |
| Admission Requirements | | | | | | | |
| Recommended Previous | Module "Embedded Systems" | | | | | | |
| Knowledge | | | | | | | |
| Educational Objectives | After taking part successfully, students have reached the following learning results | | | | | | |
| Professional Competence | | | | | | | |
| Knowledge | Cyber-Physical Systems (CPS) are tightly integrated with their surrounding environme | ent, via sen | sors, A/D and | D/A converters, a | | | |
| | actors. Due to their particular application areas, highly specialized sensors, processo | rs and actor | rs are commor | n. Accordingly, the | | | |
| | is a large variety of different specification approaches for CPS - in contrast to classica | l software e | ngineering ap | proaches. | | | |
| | Based on practical experiments using robot kits and computers, the basics of specif | ication and | modelling of | CRE are taught T | | | |
| | lab introduces into the area (basic notions, characteristical properties) and their spe- | | - | - | | | |
| | hierarchical automata, data flow models, petri nets, imperative approaches). Since C | | | - | | | |
| | | | | | | | |
| | experiments will base on simple control applications. The experiments will use state-of-the-art industrial specification tool (MATLAB/Simulink, LabVIEW, NXC) in order to model cyber-physical models that interact with the environment via sensors and | | | | | | |
| | actors. | | | | | | |
| | | | | | | | |
| | | | | | | | |
| Skills | After successful attendance of the lab, students are able to develop simple CPS. They | understand | the interdepe | endencies betwee | | | |
| | CPS and its surrounding processes which stem from the fact that a CPS interacts with the environment via sensors, A/D convertee | | | | | | |
| | digital processors, D/A converters and actors. The lab enables students to compa | are modellin | ng approache | s, to evaluate th | | | |
| | advantages and limitations, and to decide which technique to use for a concrete task | . They will | be able to app | oly these techniqu | | | |
| | to practical problems. They obtain first experiences in hardware-related software de | evelopment, | , in industry-re | elevant specificat | | | |
| | tools and in the area of simple control applications. | | | | | | |
| Personal Competence | | | | | | | |
| Social Competence | Students are able to solve similar problems alone or in a group and to present the res | ults accordi | ingly. | | | | |
| Autonomv | Students are able to acquire new knowledge from specific literature and to associate | this knowle | dae with other | r classes. | | | |
| | | | | | | | |
| | Independent Study Time 124, Study Time in Lecture 56 | | | | | | |
| Credit points | 6 | | | | | | |
| Course achievement | None | | | | | | |
| Examination | | | | | | | |
| Examination duration and | Execution and documentation of all lab experiments | | | | | | |
| scale | | | | | | | |
| Assignment for the | | | lective Compu | llsory | | | |
| Following Curricula | Computer Science: Specialisation II. Mathematics and Engineering Science: Elective C | | | | | | |
| | Computer Science: Specialisation Computer and Software Engineering: Elective Comp General Engineering Science (English program, 7 semester): Specialisation Computer | | active Comput | sory | | | |
| | Computational Science and Engineering: Specialisation II. Mathematics & Engineering | | | - | | | |
| | Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory | Science: El | ecuve compu | 1501 ý | | | |
| | Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory | | | | | | |
| | Mechatronics: Technical Complementary Course: Elective Compulsory | | | | | | |

| Course L1740: Lab Cyber-Phy | ysical Systems |
|-----------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| CP | 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. 2 nd Edition, Springer, 2012. Begleitende Foliensätze |

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.

Module M0598: Mechanical Engineering: 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 II (L0592 | | Project-/problem-based | Learning | 3 | 2 | | | | |
| Team Project Design Methodology | (L0267) | | | Project-/problem-based | Learning | 2 | 1 | | |
| Module Responsible | Prof. Diete | r Krause | | | | | | | |
| Admission Requirements | None | | | | | | | | |
| Recommended Previous | e Euro | damontals | of Mechanical Engineering | n Docian | | | | | |
| Knowledge | Mec | | or Mechanical Engineering | Design | | | | | |
| | | | of Materials Science | | | | | | |
| | | | | | | | | | |
| | • FIOC | luction Eng | Inteering | | | | | | |
| Educational Objectives | After takin | g part succ | essfully, students have re | ached the following learning results | | | | | |
| Professional Competence | | | | | | | | | |
| Knowledge | After passi | ng the mo | dule, students are able to: | | | | | | |
| | e ovn | | guidalinas far machinany | parts a g considering load situation ma | torials an | d manufacturi | ing requirement | | |
| | | | s of 3D CAD, | parts e.g. considering load situation, ma | centris dN | a manuideturi | ing requirement | | |
| | | | s of 3D CAD, methods of engineering d | esianina | | | | | |
| | - evh | uni pasies | meanous or engineering u | congranty. | | | | | |
| Skills | After passi | ng the mo | dule, students are able to: | | | | | | |
| | • inde | nendently | create sketches technica | I drawings and documentations e.g. usir | | | | | |
| | independently create sketches, technical drawings and documentations e.g. using 3D CAD, design components based on design guidelines autonomously, | | | | | | | | |
| | | | culate) used components, | | | | | | |
| | | | | ering design tasks systamtically and sol | ition orioi | atod | | | |
| | | | y techniques in teams. | | | iteu, | | | |
| | - upp | | , teeningues in teams. | | | | | | |
| Personal Competence | | | | | | | | | |
| Social Competence | After passi | ng the mo | dule, students are able to: | | | | | | |
| | develop and evaluate solutions in groups including making and documenting decisions, | | | | | | | | |
| | | develop and evaluate solutions in groups including making and documenting decisions, moderate the use of scientific methods, | | | | | | | |
| | | | | cal drawings within groups, | | | | | |
| | | | results in the work group | | | | | | |
| | | | 5 | | | | | | |
| Autonomy | Students a | re able | | | | | | | |
| , aconomy | bradenito d | ie abie | | | | | | | |
| | | | - | ng activating methods within the lectur | es (e.g. wi | th clickers), | | | |
| | • To s | olve engin | eering design tasks syster | natically. | | | | | |
| Workload in Hours | Independe | nt Study Ti | me 40, Study Time in Lec | ture 140 | | | | | |
| Credit points | 6 | | | | | | | | |
| Course achievement | | Bonus | Form | Description | | | | | |
| | Yes | None | Written elaboration | Teamprojekt Konstruktionsmethodil | c . | | | | |
| | Yes | None | Written elaboration | Konstruktionsprojekt 1 | | | | | |
| | Yes | None | Written elaboration | Konstruktionsprojekt 2 | | | | | |
| | Yes | None | Written elaboration | 3D-CAD-Praktikum | | | | | |
| Examination | Written exa | am | | | | | | | |
| Examination duration and | 180 | | | | | | | | |
| scale | | | | | | | | | |
| Assignment for the | General En | gineering | Science (German program | , 7 semester): Specialisation Mechanica | Engineer | ing: Compuls | ory | | |
| Following Curricula | General En | gineering | Science (German program | , 7 semester): Specialisation Biomedica | Engineer | ing: Compulso | ory | | |
| | General En | gineering | Science (German program | , 7 semester): Specialisation Energy and | l Envirom | ental Enginee | ring: Compulsor | | |
| | Digital Mechanical Engineering: Core Qualification: Compulsory | | | | | | | | |
| | Energy and Environmental Engineering: Core Qualification: Compulsory | | | | | | | | |
| | General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory | | | | | | | | |
| | General El | igineening | Science (English program, | / semester). Specialisation Lifergy and | LINIOINC | intai Engineer | ing. compuisory | | |

General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory Mechanical Engineering: Core Qualification: Compulsory Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory

| Tvn | Lecture |
|------------|---|
| Hrs/wk | |
| | 2 |
| СР | |
| | Independent Study Time 2, Study Time in Lecture 28 |
| | Prof. Dieter Krause |
| Language | |
| 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, aktuel |
| | Auflage. |
| | Handbuch Konstruktion; Rieg, F., Steinhilper, R.; Hanser; aktuelle Auflage. |
| | Dubbel, Taschenbuch f ür den Maschinenbau; Grote, KH., Feldhusen, I.(Hrsg.); Springer-Verlag, aktuelle Auflage. |
| | Technisches Zeichnen: Grundlagen, Normen, Beispiele, Darstellende Geometrie, Hoischen, H; Hesser, W; Cornelse |
| | 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, aktuel |
| | Auflage. |
| | Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. |

| Course L0695: Mechanical D | esign 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 D | esign Project II |
|----------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 3 |
| CP | 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. |

| ourse L0267: Team Project | Design Methodology |
|---------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 2 |
| CP | 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 |

| C | | | | |
|---|---|-------------------------|-----------------------------|------------------|
| Courses | | | | |
| Title | 1 (1 2 2 2 5) | Тур | Hrs/wk | СР |
| Fundamentals of Materials Science I (L1085) Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) (L0506) | | Lecture Lecture | 2 | 2 2 |
| Physical and Chemical Basics of Ma | | Lecture | 2 | 2 |
| Module Responsible | | | _ | |
| Admission Requirements | | | | |
| | Highschool-level physics, chemistry und mathematics | | | |
| Knowledge | ngrischool-level physics, chemistry und matiematics | | | |
| Kilowieuge | | | | |
| Educational Objectives | After taking part successfully, students have reached the follow | ving loarning rosults | | |
| Professional Competence | Arter taking part successiony, students have reached the follow | ving learning results | | |
| - | The students have acquired a fundamental knowledge on r | motals coramics and | nolymore and can doce | riba this knowla |
| Knowledge | comprehensively. Fundamental knowledge here means specific | | | |
| | phase transformations, corrosion and mechanical properties. Th | | | |
| | for materials and can identify relevant approaches for cha | | | |
| | phenomena back to the underlying physical and chemical laws | | roperties. They are able | |
| | | ornatarer | | |
| | | | | |
| | | | | |
| | | | | |
| Skills | The students are able to trace materials phenomena back t | the underlying phy | sical and chemical laws | of nature. Mate |
| | phenomena here refers to mechanical properties such as stree | ngth, ductility, and st | iffness, chemical propertie | es such as corro |
| | resistance, and to phase transformations such as solidificatio | n, precipitation, or m | nelting. The students can | explain the rela |
| | between processing conditions and the materials microstructu | ure, and they can acc | count for the impact of m | icrostructure on |
| | material's behavior. | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | - | | | |
| Autonomy | - | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 180 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 semester): S | pecialisation Mechanio | cal Engineering: Compulso | iry |
| Following Curricula | General Engineering Science (German program, 7 semester): S | pecialisation Biomedic | cal Engineering: Compulso | ry |
| | General Engineering Science (German program, 7 semester): S | pecialisation Energy a | nd Enviromental Engineer | ing: Compulsory |
| | General Engineering Science (German program, 7 semester): S | pecialisation Naval Ar | chitecture: Compulsory | |
| | General Engineering Science (German program, 7 semester): S | pecialisation Naval Ar | chitecture: Compulsory | |
| | Data Science: Specialisation Materials Science: Compulsory | | | |
| | Digital Mechanical Engineering: Core Qualification: Compulsory | | | |
| | Energy and Environmental Engineering: Core Qualification: Con | | | |
| | General Engineering Science (English program, 7 semester): Sp | | - | • • • |
| | General Engineering Science (English program, 7 semester): Sp | | | У |
| | General Engineering Science (English program, 7 semester): Sp | | | |
| | General Engineering Science (English program, 7 semester): Sp | | | У |
| | General Engineering Science (English program, 7 semester): Sp | | nitecture: Compulsory | |
| | Logistics and Mobility: Specialisation Engineering Science: Elect | tive Compulsory | | |
| | Mechanical Engineering: Core Qualification: Compulsory | | | |
| | Mechatronics: Core Qualification: Compulsory | | | |
| | Naval Architecture: Core Qualification: Compulsory | | | |
| | Technomathematics: Specialisation III. Engineering Science: Ele | achive Company Internet | | |

| Course L1085: Fundamentals | s of Materials Science I |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 P. Haasen: Physikalische Metallkunde. Springer 1994 |

| Course L0506: Fundamentals | of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Stefan Fritz 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 M0680: Fluid | Dynamics | | | |
|-----------------------------|--|--------------------------------|-------------------|--------|
| Courses | | | | |
| Title | Ту | p | Hrs/wk | СР |
| Fluid Mechanics (L0454) | | cture | 3 | 4 |
| Fluid Mechanics (L0455) | Rei | citation Section (large) | 2 | 2 |
| Module Responsible | Prof. Thomas Rung | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Sound knowledge of engineering mathematics, engineering mechan | ics and thermodynamics. | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the following le | earning results | | |
| Professional Competence | | | | |
| Knowledge | Students will have the required sound knowledge to explain the Students can scientifically outline the rationale of flow physics usin performance analysis and the prediciton of fluid engineering devices | ig mathematical models and | | |
| Skills | Students are able to apply fluid-engineering principles and flow-physics models for the analysis of technical systems. The lectur enables the student to carry out all necessary theoretical calculations for the fluid dynamic design of engineering devices on scientific level. | | | |
| Personal Competence | | | | |
| Social Competence | The students are able to discuss problems and jointly develop solution | on strategies. | | |
| Autonomy | The students are able to develop solution strategies for complex pro | blems self-consistent and crt | ically analyse re | sults. |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | |
| Credit points | 6 | | | |
| Course achievement | | | | |
| Examination | Written exam | | | |
| Examination duration and | 180 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 semester): Specia | lisation Mechanical Engineeri | ng: Compulsory | |
| Following Curricula | General Engineering Science (German program, 7 semester): Specia | | | |
| - | General Engineering Science (German program, 7 semester): Specia | | | |
| | General Engineering Science (English program, 7 semester): Special | isation Mechanical Engineerir | ng: Compulsory | |
| | General Engineering Science (English program, 7 semester): Special | isation Naval Architecture: Co | ompulsory | |
| | General Engineering Science (English program, 7 semester): Special | isation Biomedical Engineerin | ig: Compulsory | |
| | Computational Science and Engineering: Specialisation Engineering | Sciences: Elective Compulsor | У | |
| | Mechanical Engineering: Core Qualification: Compulsory | | | |
| | Naval Architecture: Core Qualification: Compulsory | | | |
| | Technomathematics: Specialisation III. Engineering Science: Elective | Compulsory | | |

| ourse L0454: Fluid Mechan | ics |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Thomas Rung |
| Language | DE/EN |
| Cycle | SoSe |
| Content | continuum physics definition of fluids, difference to solids/structures and material properties of fluids dimensional analysis and similitude fluid forces and fluid statics transport and conservation of mass, momentum & energy fluid kinematics technically relevant flow models for incompressible fluids control volume & stream tube analysis vortical flow models potential flows boundary layer flows different types of conservation equations and their realm (Navier-Stokes/Euler/Bernoulli equations) analytical solutions for Navier-Stokes systems Analysis of internal flows (channels, pipes, open channels) and external flows, fundamentals of wing aerodynamics turbulent flows fundamentals of gas dynamics (1D compressible flows) |
| Literature | the course primarily refers to / das Modul stütz sich bevorzugt auf : Munson, B.R.; Rothmayer, A.P.; Okiishi, T.H.; Huebsch, W.W.: Fundamentals of Fluid Mechanics, John Wiley & Sons. Spurk, J.; Aksel, N.: Strömungslehre, Springer. Schade, H.; Kunz, E., Kameier, F.; Paschereit, C.O.: Strömungslehere, De Gruyter. Herwig, H.: Strömungsmechanik, Springer. Herwig, H.: Strömungsmechanik von A-Z, Vieweg. |

| Course L0455: Fluid Mechani | ourse 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/EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | | |
|---|---|--|--|---------------------|--|
| Title | | Тур | Hrs/wk | СР | |
| | al Mechanics, Numerical Mechanics) (L1137) al Mechanics, Numerical Mechanics) (L1138) | Lecture Recitation Section (small) | 3 2 | 3 2 | |
| | al Mechanics, Numerical Mechanics) (L1138) | Recitation Section (small) | 1 | 1 | |
| Module Responsible | | | _ | _ | |
| Admission Requirements | | | | | |
| | Mathematics I-III and Mechanics I-III | | | | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students have reach | ed the following learning results | | | |
| Professional Competence | , the raining part succession, scale here reach | | | | |
| - | The students can | | | | |
| hitemedge | | | | | |
| | describe the axiomatic procedure used in m | echanical contexts; | | | |
| | explain important steps in model design; | | | | |
| | present technical knowledge. | | | | |
| Skills | The students can | | | | |
| | explain the important elements of mathematical elements of mathematical elements of mathematical elements and the second elements of the second elements elements of the second elements | atical / mechanical analysis and model for | mation, and apply | , it to the context | |
| | their own problems; | · · · · · · · · · · · · · · · · · · · | | | |
| | apply basic methods to engineering problem | ns; | | | |
| | estimate the reach and boundaries of the m | ethods and extend them to be applicable to | o wider problem s | sets. | |
| | | | | | |
| | | | | | |
| Personal Competence | | | | | |
| Social Competence | The students can work in groups and support each | other to overcome difficulties. | | | |
| Autonomy | Students are capable of determining their own stre | angths and weaknesses and to organize the | ir time and learn | ing based on those | |
| Autonomy | Students are capable of determining their own stre | | in time and learn | ing based on those | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture | e 84 | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and | 120 min | | | | |
| scale | | | | | |
| Assignment for the | General Engineering Science (German program, 7 | | | | |
| | | | | ory | |
| Following Curricula | General Engineering Science (German program 7 | | ·o· Compulsory | | |
| Following Curricula | | semester): Specialisation Naval Architectur | e. compaisory | | |
| Following Curricula | Energy Systems: Technical Complementary Course | e Core Studies: Elective Compulsory | | | |
| Following Curricula | Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s | e Core Studies: Elective Compulsory semester): Specialisation Mechanical Engine | eering: Compulso | ry | |
| Following Curricula | Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s | e Core Studies: Elective Compulsory emester): Specialisation Mechanical Engine emester): Specialisation Naval Architecture | eering: Compulso e: Compulsory | - | |
| Following Curricula | Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s | e Core Studies: Elective Compulsory emester): Specialisation Mechanical Engine emester): Specialisation Naval Architecture emester): Specialisation Biomedical Engine | eering: Compulso e: Compulsory | - | |
| Following Curricula | Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Compu | e Core Studies: Elective Compulsory emester): Specialisation Mechanical Engine emester): Specialisation Naval Architecture emester): Specialisation Biomedical Engine | eering: Compulso e: Compulsory | - | |
| Following Curricula | Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Compu Mechatronics: Core Qualification: Compulsory | e Core Studies: Elective Compulsory emester): Specialisation Mechanical Engine emester): Specialisation Naval Architecture emester): Specialisation Biomedical Engine ulsory | eering: Compulso e: Compulsory | - | |
| Following Curricula | Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Comput Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory | e Core Studies: Elective Compulsory semester): Specialisation Mechanical Engine semester): Specialisation Naval Architecture semester): Specialisation Biomedical Engine ulsory | eering: Compulso e: Compulsory | - | |
| Following Curricula | Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Compu Mechatronics: Core Qualification: Compulsory | e Core Studies: Elective Compulsory semester): Specialisation Mechanical Engine semester): Specialisation Naval Architecture semester): Specialisation Biomedical Engine ulsory g Science: Elective Compulsory | eering: Compulso e: Compulsory eering: Compulsor | - | |
| Following Curricula | Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Compu Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering | e Core Studies: Elective Compulsory semester): Specialisation Mechanical Engine semester): Specialisation Naval Architecture semester): Specialisation Biomedical Engine ulsory g Science: Elective Compulsory | eering: Compulso e: Compulsory eering: Compulsor | - | |
| | Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Compu Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering | e Core Studies: Elective Compulsory semester): Specialisation Mechanical Engine semester): Specialisation Naval Architecture semester): Specialisation Biomedical Engine ulsory g Science: Elective Compulsory nplementary Course Core Studies: Elective | eering: Compulso e: Compulsory eering: Compulsor | - | |
| Course L1137: Mechanics IV | Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Compu Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Theoretical Mechanical Engineering: Technical Com | e Core Studies: Elective Compulsory semester): Specialisation Mechanical Engine semester): Specialisation Naval Architecture semester): Specialisation Biomedical Engine ulsory g Science: Elective Compulsory nplementary Course Core Studies: Elective | eering: Compulso e: Compulsory eering: Compulsor | - | |
| | Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Compute Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Theoretical Mechanical Engineering: Technical Com (Oscillations, Analytical Mechanics, Numerical Lecture | e Core Studies: Elective Compulsory semester): Specialisation Mechanical Engine semester): Specialisation Naval Architecture semester): Specialisation Biomedical Engine ulsory g Science: Elective Compulsory nplementary Course Core Studies: Elective | eering: Compulso e: Compulsory eering: Compulsor | - | |
| Course L1137: Mechanics IV Typ | Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Theoretical Mechanical Engineering: Technical Com (Oscillations, Analytical Mechanics, Numerical Lecture 3 | e Core Studies: Elective Compulsory semester): Specialisation Mechanical Engine semester): Specialisation Naval Architecture semester): Specialisation Biomedical Engine ulsory g Science: Elective Compulsory nplementary Course Core Studies: Elective | eering: Compulso e: Compulsory eering: Compulsor | - | |
| Course L1137: Mechanics IV Typ Hrs/wk CP | Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Compute Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Theoretical Mechanical Engineering: Technical Com (Oscillations, Analytical Mechanics, Numerical Lecture 3 3 | e Core Studies: Elective Compulsory semester): Specialisation Mechanical Engine semester): Specialisation Naval Architecture semester): Specialisation Biomedical Engine ulsory g Science: Elective Compulsory nplementary Course Core Studies: Elective | eering: Compulso e: Compulsory eering: Compulsor | - | |
| Course L1137: Mechanics IV Typ Hrs/wk | Energy Systems: Technical Complementary Course General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s General Engineering Science (English program, 7 s Mechanical Engineering: Core Qualification: Compute Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Theoretical Mechanical Engineering: Technical Com (Oscillations, Analytical Mechanics, Numerical Lecture 3 3 | e Core Studies: Elective Compulsory semester): Specialisation Mechanical Engine semester): Specialisation Naval Architecture semester): Specialisation Biomedical Engine ulsory g Science: Elective Compulsory nplementary Course Core Studies: Elective | eering: Compulso e: Compulsory eering: Compulsor | - | |

| Language | DE |
|------------|--|
| Cycle | SoSe |
| Content | |
| | Elements of vibration theory Vibration of Multi-degree of freedom systems Analytical Mechanics 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 | (Oscillations, Analytical Mechanics, Numerical Mechanics) |
|----------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| CP | 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 | (Oscillations, Analytical Mechanics, Numerical Mechanics) |
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Robert Seifried |
| l anguage | DE |

| Language | DE |
|------------|-------------------------|
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Courses | | | | | | | |
|--|--|--|--|---|--|---|---|
| | | | | Turn | 11 | | CD. |
| Title Practical Course: Measurement an | d Control Systems (1111) | 0) | | Typ Practical Course | Hrs/v 2 | VK | CP 2 |
| Measurement Technology for Mech | - | | | Lecture | 2 | | 3 |
| Measurement Technology for Mech | | | | Recitation Section (la | | | 1 |
| Module Responsible | | | | · · · | 5. | | |
| Admission Requirements | | | | | | | |
| Recommended Previous | | hysics, chemistry | v and electrical eng | ineering | | | |
| Knowledge | Basie knowledge of p | | y and cleethear eng | lineering | | | |
| Educational Objectives | After taking part succ | cessfully, student | ts have reached the | following learning results | | | |
| Professional Competence | 51 | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | | | | | |
| | | | | ntals of the Measurement T d Systems). | echnology (Quantit | ies and | Units, Uncertai |
| | They can outline the Temperature, mechan | | | ds for different kinds of quancy). | antities to be maes | ured (E | lectrical Quanti |
| | They can describe im | portant methods | s of chemical Analys | is (Gas Sensors, Spectrosco | ppy, Gas Chromatog | raphy) | |
| Skills | Students can select s | uitable measurir | ng methods to giver | problems and can use refe | ring measurement | devices | in practice. |
| | The students are able | e to orally explai | in issues in the sub | ject area of measurement t | echnology and solu | ition app | proaches as we |
| | place the issues into | the right context | t and application are | ea. | | | |
| Personal Competence | | | | | | | |
| | Students can arrive a | t work recults in | groups and docum | ent them in a common repo | rt. | | |
| | | | | | | | |
| | | | | | | | |
| | | | | asurement technologies. | | | |
| Workload in Hours | Independent Study Ti | | | asurement technologies. | | | |
| Workload in Hours Credit points | Independent Study Ti | ime 110, Study T | Fime in Lecture 70 | | | | |
| Workload in Hours | Independent Study Ti 6 Compulsory Bonus | ime 110, Study T Form | Fime in Lecture 70 Descri | | | | |
| Workload in Hours Credit points | Independent Study Ti | ime 110, Study T Form Subject theo | Fime in Lecture 70 Descri oretical and | | | | |
| Workload in Hours Credit points Course achievement | Independent Study Ti 6 Compulsory Bonus Yes None | ime 110, Study T Form Subject theo practical work | Fime in Lecture 70 Descri oretical and | | | | |
| Workload in Hours Credit points Course achievement Examination | Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar | ime 110, Study T Form Subject theo practical work | Fime in Lecture 70 Descri oretical and | | | | |
| Workload in Hours Credit points Course achievement Examination Examination duration and | Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar | ime 110, Study T Form Subject theo practical work | Fime in Lecture 70 Descri oretical and | | | | |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale | Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes | me 110, Study T Form Subject theo practical work | Fime in Lecture 70 Descri oretical and | ption | cal Engineering: Co | mpulsor | |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S | Form Subject thee practical work nd practical work Science (German | Fime in Lecture 70 Descri oretical and n program, 7 semes | ption ter): Specialisation Mechani | | | |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale | Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S | Form Subject thee practical work nd practical work Science (German Science (German | Fime in Lecture 70 Descri oretical and n program, 7 semes n program, 7 semes | ption ter): Specialisation Mechani ter): Specialisation Biomedi | cal Engineering: Co | mpulsor | у |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S | Form Subject thee practical work nd practical work Science (Germar Science (Germar Science (Germar | Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes | ter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a | cal Engineering: Co | mpulsor | у |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S General Engineering S Digital Mechanical En | Form Subject thee practical work nd practical work Science (Germar Science (Germar Science (Germar | Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes Qualification: Comp | ter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory | cal Engineering: Co | mpulsor | y |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S General Engineering S Digital Mechanical En Energy and Environm | Form Subject thee practical work nd practical work Science (Germar Science (Germar Science (Germar gineering: Core tental Engineerin | Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes Qualification: Comp ng: Core Qualificatio | ter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory | cal Engineering: Co | mpulsor | у |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S General Engineering S Digital Mechanical En Energy and Environm | Form Subject thee practical work nd practical work Science (Germar Science (Germar Science (Germar gineering: Core tental Engineerin Specialisation M | Time in Lecture 70 Description oretical and oretical and oretical and oregram, 7 semes or program, 7 semes Qualification: Comp og: Core Qualificatio lechatronics: Comp | ter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory Jlsory | cal Engineering: Co | mpulsor | y |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: | Form Subject thee practical work nd practical work Science (Germar Science (Germar Science (Germar science (Germar spienering: Core tental Engineerin Specialisation M | Time in Lecture 70 Descri oretical and and and and and and and and | ter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory Jlsory | cal Engineering: Co | mpulsor | y |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S General Engineering S Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: | Form Subject thee practical work nd practical work Science (Germar Science (Germar Science (Germar science (Germar gineering: Core tental Engineerin Specialisation M Specialisation B | Time in Lecture 70 Descri oretical and and and and and and and and | ter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory ulsory ing: Compulsory ng: Elective Compulsory | cal Engineering: Co and Enviromental Er | mpulsor | y ng: Compulsory |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering S | Form Subject thee practical work and practical work digractical work Science (German Science (German Science (German Specialisation M Specialisation M Specialisation Bi Science (English | Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes Qualification: Compu g: Core Qualificatio lechatronics: Compu lechanical Engineer iomedical Engineer program, 7 semest | ter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory ulsory ing: Compulsory | cal Engineering: Co and Enviromental Er nd Enviromental En | mpulsor ngineerin gineerin | y ng: Compulsory g: Compulsory |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering S | Form Subject thee practical work and practical work and practical work Science (Germar Science (Germar Science (Germar Science (Germar specialisation M Specialisation M Specialisation B Science (English Science (English | Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes Qualification: Compu g: Core Qualification lechatronics: Compu lechanical Engineer iomedical Engineer program, 7 semest program, 7 semest | ter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory ulsory ing: Compulsory ng: Elective Compulsory er): Specialisation Energy a | cal Engineering: Co and Enviromental Er nd Enviromental En ral Engineering: Cor | mpulsor ngineerin gineerin npulsory | y ng: Compulsory g: Compulsory |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering S General Engineering S | Form Subject thee practical work and practical work and practical work Science (Germar Science (Germar Science (Germar Specialisation M Specialisation M Specialisation M Specialisation B Science (English Science (English Science (English | Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes Qualification: Compu g: Core Qualification lechatronics: Compu lechanical Engineer iomedical Engineer program, 7 semest program, 7 semest program, 7 semest | etter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory ulsory ing: Compulsory ng: Elective Compulsory er): Specialisation Energy a er): Specialisation Mechanic | cal Engineering: Co and Enviromental En nd Enviromental En ral Engineering: Cor al Engineering: Con | mpulsor ngineerin gineerin npulsory | y ng: Compulsory g: Compulsory |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering S General Engineering S General Engineering S General Engineering S | Form Subject thee practical work and practical work digractical work Science (German Science (German Science (German Specialisation M Specialisation M Specialisation M Specialisation B Science (English Science (English Science (English Science (English | Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes Qualification: Compu lecharical Engineer iomedical Engineer program, 7 semest program, 7 semest program, 7 semest program, 7 semest | etter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory ulsory ng: Compulsory ng: Elective Compulsory er): Specialisation Energy a er): Specialisation Mechanic er): Specialisation Biomedic | cal Engineering: Co and Enviromental En ad Enviromental En cal Engineering: Cor al Engineering: Con nics: Compulsory | mpulsor ngineerin npulsory npulsory | y ng: Compulsory g: Compulsory |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering S General Engineering S General Engineering S General Engineering S General Engineering S | Form Subject thee practical work nd practical work nd practical work Science (Germar Science (Germar Science (Germar Specialisation M Specialisation M Specialisation M Specialisation Bi Science (English Science (English Science (English Science (English Science (English Science (English | Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes Qualification: Compu lecharical Engineer iomedical Engineer program, 7 semest program, 7 semest program, 7 semest program, 7 semest program, 7 semest program, 7 semest | ettion ter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory ulsory ng: Compulsory ng: Elective Compulsory er): Specialisation Energy a er): Specialisation Mechanic er): Specialisation Biomedic er): Specialisation Mechatro | cal Engineering: Co and Enviromental En al Engineering: Cor al Engineering: Con nics: Compulsory al Engineering: Cor | mpulsor ngineerin npulsory npulsory npulsory | y ng: Compulsory g: Compulsory |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering S General Engineering S Genera | Form Subject thee practical work and practical work and practical work Science (Germar Science (Germar Science (Germar Specialisation M Specialisation M Specialisation M Specialisation M Specialisation B Science (English Science (English Science (English Science (English Science (English Science (English Science (English Science (English | Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes Qualification: Compu lecharical Engineer iomedical Engineer program, 7 semest program, 7 semest | etter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory ulsory ng: Elective Compulsory er): Specialisation Energy a er): Specialisation Mechanic er): Specialisation Mechanic er): Specialisation Mechanic | cal Engineering: Co and Enviromental En al Engineering: Cor al Engineering: Con nics: Compulsory al Engineering: Cor al Engineering: Elec | mpulsor ngineerin npulsory npulsory npulsory | y ng: Compulsory g: Compulsory |
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| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study Ti 6 Compulsory Bonus Yes None Subject theoretical ar 105 minutes General Engineering S General Engineering S Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering S General Engineering S Genera | Form Subject thee practical work and practical work and practical work science (Germar Science (Germar Science (Germar Specialisation M Specialisation M Specialisation M Specialisation M Specialisation M Specialisation B Science (English Science (English | Time in Lecture 70 Descri oretical and c n program, 7 semes n program, 7 semes n program, 7 semes Qualification: Compu lechanical Engineer iomedical Engineer program, 7 semest program, 7 semes | etter): Specialisation Mechani ter): Specialisation Biomedi ter): Specialisation Energy a ulsory n: Compulsory ulsory ng: Elective Compulsory er): Specialisation Energy a er): Specialisation Mechanic er): Specialisation Mechanic er): Specialisation Mechanic er): Specialisation Mechanic er): Specialisation Mechanic er): Specialisation Mechanic | cal Engineering: Co and Enviromental En al Engineering: Cor al Engineering: Con nics: Compulsory al Engineering: Cor al Engineering: Elec | mpulsor ngineerin npulsory npulsory npulsory | y ng: Compulsory g: Compulsory |
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| | Practical Course |
|------------|---|
| Hrs/wk | |
| CP | |
| | Independent Study Time 32, Study Time in Lecture 28 |
| | Prof. Thorsten Kern |
| Language | |
| 2 | WiSe/SoSe |
| Content | Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseo pollutants in automotive exhaust are used. |
| | Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine w be investigated. The starting will be simulated on a PC and compared with measurement. |
| | Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will be understood and applications w 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 am Arbeitsplatz. 2. Au Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974 Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenbu Verlag, München-Wien, 1979 Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltur Gebrauchs- und Bedienungsanweisungen VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 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 Verlag, Heidelberg, 1984 Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988 Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989 Versuch 4: Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden |

| Course L1116: Measurement | : Technology for Mechanical Engineering |
|---------------------------|---|
| Тур | Lecture |
| Hrs/wk | |
| СР | 3 |
| | |
| | Prof. Thorsten Kern, Dennis Kähler |
| Language | |
| Cycle | Vise 1 Fundamentals |
| Content | 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 |
| | 2.6 Data Transmission |
| | 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 |
| Literature | Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springer, 2006, ISBN: 978-3-540-34055- 3. |
| | Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 978-3486217940. |

| Course L1118: Measurement | Technology for Mechanical Engineering |
|---------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Thorsten Kern |
| Language | EN |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

Focus Biomechanics

| Modulo MOEOZi Advo | iomechanics get in addition to their core eng ables them to understand operational planni | ng as well as research and development in | this highly inter | disciplinary area |
|--|--|--|--|---|
| Module M0597: Adva | nced Mechanical Engineering De | sign | | |
| Courses | | | | |
| Γitle | | Тур | Hrs/wk | СР |
| Advanced Mechanical Engineering | Design II (L0264) | Lecture | 2 | 2 |
| Advanced Mechanical Engineering | | Recitation Section (large) | 2 | 1 |
| Advanced Mechanical Engineering Advanced Mechanical Engineering | | Lecture Recitation Section (large) | 2 | 2 1 |
| Module Responsible | | | _ | _ |
| Admission Requirements | | | | |
| Recommended Previous | • | | | |
| Knowledge | Fundamentals of Mechanical Engineering Mechanics | g Design | | |
| | Fundamentals of Materials Science | | | |
| | Production Engineering | | | |
| Educational Objections | | | | |
| Professional Competence | After taking part successfully, students have re | ached the following learning results | | |
| - | After passing the module, students are able to: | | | |
| euge | | | | |
| | | functions of machine elements and of basic ele | | |
| | explain requirements, selection criteria, indicate the background of dimensioning | application scenarios and practical examples o calculations | or complex machi | ne elements, |
| | | | | |
| Skills | After passing the module, students are able to: | | | |
| | accomplish dimensioning calculations of | covered machine elements, | | |
| | | e to new requirements and tasks (problem sol | ving skills), | |
| | recognize the content of technical drawin | ngs and schematic sketches, | | |
| | evaluate complex designs, technically. | | | |
| Personal Competence | | | | |
| Social Competence | | formation in the lecture supported by activatin | a methods | |
| | | | g methodol | |
| Autonomy | Students are able to independently deep | en their acquired knowledge in exercises. | | |
| | • Students are able to acquire additional | knowledge and to recapitulate poorly unders | tood content e.g | . by using the vid |
| | recordings of the lectures. | | | |
| Workload in Hours | Independent Study Time 68, Study Time in Lect | ture 112 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | | | | |
| scale | | | | |
| Assignment for the | | - | | |
| | General Engineering Science (German progr | am, 7 semester): Specialisation Mechanica | | - |
| Following Curricula | Compulson | | l Engineering, F | - |
| Following Curricula | Compulsory General Engineering Science (German progra | am 7 semester): Specialisation Mechanical (| | ocus Biomechani |
| Following Curricula | Compulsory General Engineering Science (German progra Compulsory | am, 7 semester): Specialisation Mechanical I | | ocus Biomechani |
| Following Curricula | General Engineering Science (German progra | | Engineering, Foc | ocus Biomechani us Energy Systen |
| Following Curricula | General Engineering Science (German progra Compulsory | | Engineering, Foc | ocus Biomechani us Energy Systen |
| Following Curricula | General Engineering Science (German progra Compulsory General Engineering Science (German progra Engineering: Compulsory General Engineering Science (German prog | am, 7 semester): Specialisation Mechanical | Engineering, Foc Engineering, Foc | ocus Biomechani us Energy Systen us Aircraft Syster |
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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 Naval Architecture: Core Qualification: Compulsory

| Course L0264: Advanced Med | chanical Engineering Design II |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 |
| | 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. |
| | Sowie weitere Bücher zu speziellen Themen |
| | |

 Course Lo265: Advanced W=rickl Engineering Design II

 Course Lo265: Advanced W=rickl Engineering Design II

 Recitation Section (large)

 Recitation Section (large)

 Image: Profestion Section (large)

 Point Section Section (large)

 Image: Profestion Section Secti

| Hrs/wk 2 Or Valadia Muss Independent Study Time 32, Study Time in Lecture 28 Vorkhadia Muss Independent Study Time 32, Study Time in Lecture 28 Lecture Prof. Dieter Krause, Prof. Otto von Estorff Language DE Cycle Wise Content Advanced Mechanical Engineering Design 1 & II Lecture Fundamentals of the following machine elements: Linear rolling bearings Axes & shafts Seals Cutches & torakes Belt & chain drives Exercise Elements of fluidics Ecercise Calculation methods of the following machine elements: Linear rolling bearings Teamer of fluidics Exercise Elements of fluidics Exercise Belt & chain drives Gear drives Belt & chain drives Gear drives Studing bearings Axes & shafts Outches & torakes Belt & chain drives Gear drives Studing bearings Calculation methods of the following machine elements: Calculation methods of the following machine elements: Calculation methods of the following machine elements: Calculation for hydrostatic systems (fluidics) Calculation methods of the following machine elements: Schort Hydrostatic systems (fluidics) Calculation for hydrostatic systems (fluidics) Calculation for hydrostatic systems (fluidics) | Тур | Lecture |
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| 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, aktuellage. | | Epicyclic gears |
| 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, aktuellage. | | Crank gears |
| 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, aktuellage. | | Sliding bearings |
| 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, aktuellage. | | Calculations of hydrostatic systems (fluidics) |
| 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, aktuellage. | Literature | • Dubbel, Taschenbuch für den Maschinenbau: Grote, KH., Feldhusen, I.(Hrsg.): 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, aktuellage. | | |
| 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, ak 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, ak Auflage. | | |
| Maschinenelemente 1-2; Schlecht, B., Pearson Verlag, aktuelle Auflage. Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, ak Auflage. | | |
| Maschinenelemente - Gestaltung, Berechnung, Anwendung; Haberhauer, H., Bodenstein, F., Springer-Verlag, ak Auflage. | | |
| Auflage. | | |
| | | |
| | | |

| Course L0263: Advanced Me | Course L0263: Advanced Mechanical Engineering Design I | | |
|---------------------------|--|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| CP | 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 | Typ Hrs/wk CP |
| ntroduction to Anatomy (L0384) | Lecture 2 3 |
| Module Responsible | Prof. Udo Schumacher |
| Admission Requirements | None |
| Recommended Previous | None |
| Knowledge | |
| Educational Objectives | After taking part successfully, students have reached the following learning results |
| Professional Competence | |
| Knowledge | The students can describe basal structures and functions of internal organs and the musculoskeletal system. |
| | The students can describe the basic macroscopy and microscopy of those systems. |
| Skills | The students can recognize the relationship between given anatomical facts and the development of some common diseases; the |
| | 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 biomedical research and medicine on a professional level. |
| Autonomy | The students are able to access anatomical knowledge by themselves, can participate in conversations on the topic and acquing |
| | the relevant knowledge themselves. |
| | |
| | Independent Study Time 62, Study Time in Lecture 28 |
| Credit points | |
| Course achievement | |
| Examination | |
| Examination duration and | |
| scale | |
| - | General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory |
| Following Curricula | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan |
| | Compulsory |
| | Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory |
| | Engineering Science: Specialisation Biomedical Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan |
| | 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 Biomedical Engineering: Compulsory Mechanical Engineering: Specialisation Biomechanics: Compulsory |
| | |
| | Mechanical Engineering: Specialisation Biomechanics: Compulsory |
| | Mechanical Engineering: Specialisation Biomechanics: Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective 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 |

| urse L0384: Introduction t | to Anatomy | | |
|----------------------------|--|--|--|
| Тур | | | |
| Hrs/wk | | | |
| СР | | | |
| | Independent Study Time 62, Study Time in Lecture 28 | | |
| | r Prof. Tobias Lange | | |
| Language | | | |
| | SoSe | | |
| content | 1 st week: The Eucaryote Cell | | |
| | 2 nd week: The Tissues | | |
| | 3 rd week: Cell Cycle, Basics in Development 4 th week: Musculoskeletal System | | |
| | 5 th week: Cardiovascular System | | |
| | 6 th week: Respiratory System | | |
| | 7 th week: Genito-urinary System 8 th week: Immune system | | |
| | 8 th week: Immune system 9 th week: Digestive System I | | |
| | 10 th week: Digestive System II | | |
| | 11 th week: Endocrine System | | |
| | 12 th week: Nervous System | | |
| | 13 th week: Exam | | |
| Literature | Adolf Faller/Michael Schünke, Der Körper des Menschen, 17. Auflage, Thieme Verlag Stuttgart, 2016 | | |

| Courses | | | | | |
|--|---|--|-----------------------------|----------------------|--|
| Title | | Тур | Hrs/wk | СР | |
| ntroduction to Radiology and Radi | ation Therapy (L0383) | Lecture | 2 | 3 | |
| Module Responsible | Prof. Ulrich Carl | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | None | | | | |
| | After taking part successfully, studen | ts have reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | | | | | |
| | The students can distinguish different | t types of currently used equipment with respect | to its use in radiation the | erapy. | |
| | The students can explain treatment p | lans used in radiation therapy in interdisciplinar | y contexts (e.g. surgery, | internal medicine). | |
| | The students can describe the pa | tients' passage from their initial admittanc | e through to follow-up | care. | |
| | Diagnostics | | | | |
| | _ | ical base concerns of projection radiography, i | | d | |
| | well as sectional imaging techniques | hical base concepts of projection radiography, ir (CT, MRT, US). | iciuding anglography an | u mammograpny, a | |
| | The students can explain the diagnost techniques. | stic as well as therapeutic use of imaging techni | iques, as well as the tech | nnical basis for tho | |
| | The students can choose the right tre | atment method depending on the patient's clinic | cal history and needs. | | |
| | The student can explain the influence | of technical errors on the imaging techniques. | | | |
| | The student can draw the right conclu | usions based on the images' diagnostic findings | or the error protocol | | |
| | The student can draw the right conclusions based on the images' diagnostic findings or the error protocol. | | | | |
| Skills | s Therapy The students can distinguish curative and palliative situations and motivate why they came to that conclusion. | | | | |
| | The students can develop adequate therapy concepts and relate it to the radiation biological aspects. | | | | |
| | The students can use the therapeutic | principle (effects vs adverse effects) | | | |
| | The students can distinguish differen | nt kinds of radiation, can choose the best one | depending on the situa | tion (location of t | |
| | - | d in that situation (irradiation planning). | | | |
| | The student can assess what an inc groups, self-help groups, social service | dividual psychosocial service should look like (ces, psycho-oncology). | e.g. follow-up treatment | t, sports, social he | |
| | Diagnostics | | | | |
| | The students can suggest solutions for | or repairs of imaging instrumentation after having | g done error analyses. | | |
| | The students can classify results of anatomy, pathology and pathophysio | imaging techniques according to different grou logy. | ips of diseases based or | n their knowledge | |
| Borconal Competence | | | | | |
| Personal Competence Social Competence | The students can assess the special social situation of tumor patients and interact with them in a professional way. The students are aware of the special, often fear-dominated behavior of sick people caused by diagnostic and therapeut measures and can meet them appropriately. | | | | |
| Autonomy | The students can apply their new kno | wledge and skills to a concrete therapy case. | | | |
| | The students can introduce younger s | | | | |
| | The students are able to access anatomical knowledge by themselves, can participate competently in conversations on the and acquire the relevant knowledge themselves. | | | rsations on the top | |
| Workload in Hours | Independent Study Time 62, Study Ti | me in Lecture 28 | | | |
| Credit points | | | | | |
| Course achievement | None | | | | |
| Examination | | | | | |
| Examination duration and scale | 90 minutes | | | | |
| | General Engineering Science (German | n program, 7 semester): Specialisation Biomedic | al Engineering: Compulso | ory | |
| Following Curricula | General Engineering Science (Gern | nan program, 7 semester): Specialisation Me | chanical Engineering, F | ocus Biomechanic | |
| | Compulsory | . Commulaan | | | |
| | Data Science: Specialisation Medicine Electrical Engineering: Specialisation | e: Compulsory Medical Technology: Elective Compulsory | | | |
| | Engineering Science: Specialisation B | | | | |
| | | ish program, 7 semester): Specialisation Me | chanical Engineering, F | ocus Biomechanic | |
| | Compulsory General Engineering Science (English | program, 7 semester): Specialisation Biomedica | l Engineering: Compulso | rv | |
| | | program, 7 semester): Specialisation Biomedica | | | |
| | Mechanical Engineering: Specialisatio | n Biomechanics: Compulsory | | | |
| | | n Medical Technology and Control Theory: Electi | | | |

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: Specialisation III. Engineering Science: Elective Compulsory

| Тур | Lecture |
|----------------------|---|
| Hrs/wk | 2 |
| СР | |
| | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer Language | Prof. Ulrich Carl, Prof. Thomas Vestring |
| Cycle | |
| | The students will be given an understanding of the technological possibilities in the field of medical imagin interventional radiology and radiation therapy/radiation oncology. It is assumed, that students in the beginning of th course have heard the word "X-ray" at best. It will be distinguished between the two arms of diagnostic (Prof. Dr. med. Thomas Vestring) and therapeutic (Prof. Dr. med. Ulrich Carl) use of X-rays. Both arms depend on special big units which determine a predefined sequence in their respective departments |
| 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 – erschienen 08.12.2009 |
| | ISBN: 978-3-437-47501-6 |
| | • "Taschenatlas der Physiologie" von S. Silbernagel und A. Despopoulus- |
| | 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 |
| | 1. Adnuge - Springer-Venag Gribh - erschlenen 02.00.2000 |

| Courses | | | | |
|------------------------------------|---|---|-------------------------|-----------------|
| Title | | Тур | Hrs/wk | СР |
| Introduction to Biochemistry and M | olecular Biology (L0386) | Lecture | 2 | 3 |
| Module Responsible | Prof. Hans-Jürgen Kreienkamp | | | |
| Admission Requirements | None | | | |
| Recommended Previous | None | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, studer | ts have reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students can | | | |
| | describe basic biomolecules; | | | |
| | explain how genetic information | on is coded in the DNA; | | |
| | explain the connection between | en DNA and proteins; | | |
| | The shudents are | | | |
| SKIIIS | The students can | | | |
| | recognize the importance of m | nolecular parameters for the course of a disease; | | |
| | describe selected molecular-d | iagnostic procedures; | | |
| | explain the relevance of these | procedures for some diseases | | |
| Personal Competence | | | | |
| • | The students can participate in discu | ssions in research and medicine on a technical leve | el. | |
| | | | | |
| Autonomy | The students can develop understan | ding of topics from the course, using technical liter | ature, by themselves. | |
| Workload in Hours | Independent Study Time 62, Study T | ime in Lecture 28 | | |
| Credit points | 3 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 60 minutes | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (Germa | n program, 7 semester): Specialisation Biomedical | Engineering: Compulsory | y |
| Following Curricula | General Engineering Science (Gen | man program, 7 semester): Specialisation Mech | hanical Engineering, Fo | cus Biomechanio |
| | Compulsory | | | |
| | Data Science: Specialisation Medicin | | | |
| | | Medical Technology: Elective Compulsory | | |
| | Engineering Science: Specialisation E | program, 7 semester): Specialisation Biomedical I | Engineering, Compulsory | |
| | | lish program, 7 semester): Specialisation Biomedican | | |
| | Compulsory | isin program, 7 semestery. Specialisation meet | lanical Engineering, 10 | Sus Diomeenanie |
| | Mechanical Engineering: Specialisati | on Biomechanics: Compulsory | | |
| | | on Management and Business Administration: Elect | ive Compulsory | |
| | Biomedical Engineering: Specialisatio | on Artificial Organs and Regenerative Medicine: Ele | ctive Compulsory | |
| | Biomedical Engineering: Specialisatio | on Medical Technology and Control Theory: Elective | e Compulsory | |
| | Biomedical Engineering: Specialisation | on Implants and Endoprostheses: Elective Compuls | ory | |

| Course L0386: Introduction t | o Biochemistry and Molecular Biology |
|------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Hans-Jürgen Kreienkamp |
| Language | DE |
| Cycle | WiSe |
| Content | |
| Literature | Müller-Esterl, Biochemie, Spektrum Verlag, 2010; 2. Auflage |
| | Löffler, Basiswissen Biochemie, 7. Auflage, Springer, 2008 |

| Courses | | | | |
|---------------------------------|--|---|---|--|
| Title | | Тур | Hrs/wk | СР |
| Numerical Mathematics I (L0417) | | Lecture | 2 | 3 |
| Numerical Mathematics I (L0418) | | Recitation Section (small) | 2 | 3 |
| Module Responsible | Prof. Sabine Le Borne | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mathematik I + II for Engineering Students (| german or english) or Analysis & Linear Al | rebra I + II for Te | chnomathematic |
| Knowledge | basic MATLAB/Python knowledge | german of englishy of Analysis a Enfeat Ag | | ennomathematik |
| | | | | |
| | After taking part successfully, students have reach | ed the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to | | | |
| | name numerical methods for interpolation, | integration, least squares problems, eigenv | value problems, r | onlinear root fin |
| | problems and to explain their core ideas, | | | |
| | repeat convergence statements for the num | nerical methods, | | |
| | explain aspects for the practical execution of | of numerical methods with respect to comp | utational and stor | rage complexitx. |
| | | | | |
| | | | | |
| Skills | Students are able to | | | |
| | implement, apply and compare numerical m | nethods using MATLAB/Python | | |
| | justify the convergence behaviour of numer | | nd solution algori | thm |
| | select and execute a suitable solution appro | | na seración argen | , |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to | | | |
| | work together in heterogeneously compose | d teams (i.e., teams from different study pr | ograms and bac | karound knowled |
| | explain theoretical foundations and support | | | |
| | | | | |
| Autonomy | Students are capable | | | |
| | to assess whether the supporting theoretica | l and practical excercises are better solved | individually or in | a team. |
| | to assess their individual progess and, if neo | | , | |
| | | | | |
| Workload in Hours | | re 56 | | |
| Credit points | | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 minutes | | | |
| scale | | | | |
| | General Engineering Science (German program, 7 | | | |
| Following Curricula | General Engineering Science (German program | n, 7 semester): Specialisation Mechanic | al Engineering, | Focus Material |
| | Engineering Sciences: Compulsory | | | |
| | General Engineering Science (German program, 7 | | | |
| | General Engineering Science (German program | , 7 semester): Specialisation Mechanica | i Engineering, F | ocus Biomecna |
| | Compulsory General Engineering Science (German program, 7 | semester). Specialisation Mechanical Engin | eering Focus Th | enetical Mecha |
| | General Engineering Science (German program, 7 Engineering: Compulsory | semestery. Specialisation Mechanical Engli | icening, rocus III | corectar Metrid |
| | | 7 semester): Specialisation Mechanical | Engineering Foo | |
| | General Engineering Science German program | | , 100 | us Aircraft Svet |
| | General Engineering Science (German program, Engineering: Elective Compulsory | | | us Aircraft Syst |
| | Engineering: Elective Compulsory | | neering, Focus M | |
| | | | neering, Focus M | |
| | Engineering: Elective Compulsory General Engineering Science (German program, 7 | semester): Specialisation Mechanical Engli | | echatronics: Elec |
| | Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory | semester): Specialisation Mechanical Engli | | echatronics: Elec |
| | Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, | semester): Specialisation Mechanical Engin 7 semester): Specialisation Mechanical I | Engineering, Foc | echatronics: Elec |
| | Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory | semester): Specialisation Mechanical Engin 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulse | Engineering, Foc | echatronics: Elec |
| | Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General | semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory | Engineering, Foc | echatronics: Elec |
| | Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M | semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory | Engineering, Foc | echatronics: Elec |
| | Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a | semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical f Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulso | Engineering, Foc | echatronics: Elec |
| | Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory | semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulso Compulsory | Engineering, Foc | echatronics: Elec |
| | Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective | semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulso Compulsory ry | Engineering, Foc | echatronics: Elec |
| | Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Engineering Science: Core Qualification: Compulso Engineering Science: Core Qualification: Compulso General Engineering Science (English program, 7 s | semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory ry ry emester): Core Qualification: Compulsory | Engineering, Foc vry ory | echatronics: Elec |
| | Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Engineering Science: Core Qualification: Compulso Engineering Science: Core Qualification: Compulso General Engineering Science (English program, 7 General Engineering Science (English program, 7 Science (English program, 7 Science) English program, 7 Science (English program, 7 Science) Engineering Science (English program, 7 Science) English program, 7 Science (English program, 7 Science) English program | semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory ry ry emester): Core Qualification: Compulsory emester): Specialisation Computer Science | Engineering, Foc nry pry : Compulsory | echatronics: Elec us Energy Syste |
| | Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Engineering Science: Core Qualification: Compulso Engineering Science: Core Qualification: Compulso General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, 7 | semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory ry ry emester): Core Qualification: Compulsory emester): Specialisation Computer Science | Engineering, Foc nry pry : Compulsory | echatronics: Elec us Energy Syste |
| | Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Engineering Science: Core Qualification: Compulso Engineering Science: Core Qualification: Compulso General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, 7 Scompulsory | semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory ry ry remester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical | Engineering, Foc ory ory : Compulsory Engineering, F | echatronics: Elec us Energy Syste ocus Biomecha |
| | Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Engineering Science: Core Qualification: Compulso Engineering Science: Core Qualification: Compulso General Engineering Science (English program, 7 General Engineering Science (English program, 7 Scompulsory | semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory ry ry remester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical | Engineering, Foc ory ory : Compulsory Engineering, F | echatronics: Elec us Energy Syste ocus Biomecha |
| | Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Engineering Science: Core Qualification: Compulso Engineering Science: Core Qualification: Compulso General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, Compulsory General Engineering Science (English program, 7 Sciences: Compulsory | semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory ry ry emester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine | Engineering, Foc ory : Compulsory Engineering, F eering, Focus Mat | echatronics: Elec us Energy Syste ocus Biomecha eerials in Enginee |
| | Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Engineering Science: Core Qualification: Compulso Engineering Science: Core Qualification: Compulso General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 | semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory ry ry emester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine | Engineering, Foc ory : Compulsory Engineering, F eering, Focus Mat | echatronics: Elec us Energy Syste ocus Biomecha eerials in Enginee |
| | Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Engineering Science: Core Qualification: Compulso General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Engineering: Compulsory | semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical E Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory ry ry remester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine | Engineering, Foc ory : Compulsory Engineering, F eering, Focus Mat eeering, Focus Th | echatronics: Elec us Energy Syste ocus Biomecha erials in Enginee eoretical Mecha |
| | Engineering: Elective Compulsory General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Engineering Science: Core Qualification: Compulso Engineering Science: Core Qualification: Compulso General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 | semester): Specialisation Mechanical Engli 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso lathematics: Elective Compulsory and Engineering Science: Elective Compulsor Compulsory ry ry emester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical Engine semester): Specialisation Mechanical Engine emester): Specialisation Mechanical Engine | Engineering, Foc ory : Compulsory Engineering, F eering, Focus Mat eering, Focus Th eering: Compulsor | echatronics: Elec us Energy Syste ocus Biomecha eerials in Enginee eoretical Mecha |

Computational Science and Engineering: Core Qualification: Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Mechanical Engineering: Specialisation Mechatronics: Elective Compulsory

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

Process Engineering: Specialisation Process Engineering: Elective Compulsory

| Course L0417: Numerical Ma | ourse L0417: Numerical Mathematics I | | | | |
|----------------------------|--|--|--|--|--|
| Тур | Lecture | | | | |
| Hrs/wk | | | | | |
| CP | | | | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | | | |
| Lecturer | Prof. Sabine Le Borne | | | | |
| Language | EN | | | | |
| Cycle | WiSe | | | | |
| Content | Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss quadrature, adaptive quadrature | | | | |
| Literature | Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer | | | | |

| Course L0418: Numerical Ma | rse L0418: Numerical Mathematics I | | |
|----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| CP | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Sabine Le Borne, Dr. Jens-Peter Zemke | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | |
|---|---|--|---------------------------|------------------|
| Courses Title | | Tun | Hrs/wk | СР |
| Incle Implants and Fracture Healing (L03 | 76) | Typ Lecture | ПГ5/WK 2 | 3 |
| Module Responsible | | | | |
| Admission Requirements | None | | | |
| Recommended Previous | It is recommended to participate in "Intro | duction into Anatomie" before attending "Imp | plants and Fracture Heal | ing". |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students h | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students can describe the different w | ays how bones heal, and the requirements fo | or their existence. | |
| | The students can name different treatme | nts for the spine and hollow bones under give | en fracture morphologies | i. |
| Skills | The students can determine the forces a | ting within the human body under quasi-stati | ic situations under speci | fic assumptions. |
| | | | | |
| Personal Competence | | | | |
| Social Competence | The students can, in groups, solve basic r | numerical modeling tasks for the calculation o | of internal forces. | |
| Autonomy | The students can, in groups, solve basic numerical modeling tasks for the calculation of internal forces. | | | |
| Workload in Hours | Independent Study Time 62, Study Time | in Lecture 28 | | |
| Credit points | 3 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German | program, 7 semester): Specialisation Med | chanical Engineering, F | ocus Biomechani |
| Following Curricula | Compulsory | | | |
| | General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory | | | ory |
| | Engineering Science: Specialisation Biom | | | |
| | | gram, 7 semester): Specialisation Biomedical | | - |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biome | | | |
| | Compulsory | | | |
| | Mechanical Engineering: Specialisation Bi | omechanics: Compulsory | | |
| | Biomedical Engineering: Specialisation In | plants and Endoprostheses: Elective Compute | sory | |
| | | tificial Organs and Regenerative Medicine: El | | |
| | Biomedical Engineering: Specialisation M | anagement and Business Administration: Elec | tive Compulsory | |
| | Biomedical Engineering: Specialisation M | edical Technology and Control Theory: Electiv | e Compulsory | |
| | | | | |
| | Orientation Studies: Core Qualification: El | lective Compulsory | | |

| Course L0376: Implants and | Fracture Healing |
|----------------------------|--|
| - | Lecture |
| | |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Michael Morlock |
| Language | DE |
| Cycle | WiSe |
| Content | Topics to be covered include: |
| | 1. 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) |
| | 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 |
| Literature | 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 |
| | Nigg, B.: Biomechanics of the musculo-skeletal system |
| | Schiebler T.H., Schmidt W.: Anatomie |
| | Platzer: dtv-Atlas der Anatomie, Band 1 Bewegungsapparat |
| | |
| | |
| | |

| Courses | | | | | |
|------------------------------|--|---|--|-------------------|--|
| Title | | Тур | Hrs/wk | СР | |
| Computer Engineering (L0321) | | Lecture | 3 | 4 | |
| Computer Engineering (L0324) | | Recitation Section (small) | 1 | 2 | |
| Module Responsible | Prof. Heiko Falk | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Basic knowledge in electrical engineering | | | | |
| Knowledge | | | | | |
| Educational Objectives | | d 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- 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 Insut/output, 1/O from the parametrize of the CPU, principles of passing data, point to point compacting, burger | | | | |
| Skills | 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 physic composition of computer systems. The students can analyze, how highly specific and individual computers can be built based or collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers 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 comput system and the software executed on it. In particular, they shall understand the consequences that the execution of software how the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evalua 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 | r in a group and to present the results a | cordingly. | | |
| Autonomy | Students are able to acquire new knowledge from s | pecific literature and to associate this ki | nowledge with othe | r classes. | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | | |
| Credit points | | | | | |
| Course achievement | Compulsory Bonus Form Description | | | | |
| | Yes 10 % Excercises | | | | |
| Examination | Written exam | | | | |
| Examination duration and | 90 minutes, contents of course and labs | | | | |
| scale | | | | | |
| Assignment for the | | | | | |
| Following Curricula | | | | | |
| | General Engineering Science (German program, 7 s | | | | |
| | General Engineering Science (German program, | / semester): Specialisation Mechan | cal Engineering, I | -ocus Mechatroni | |
| | Compulsory | 7 compostor), Specialization Machanics | L Engineering For | un Aircraft Sucto | |
| | General Engineering Science (German program, Engineering: Compulsory | 7 semester): specialisation Mechanica | i Engineering, Foc | us Aircrait Syste | |
| | General Engineering Science (German program, 7 s | emester): Specialisation Mechanical En | aineerina. Focus Th | eoretical Mechani | |
| | Engineering: Compulsory | | jineering, roedo rii | | |
| | General Engineering Science (German program, | , 7 semester): Specialisation Mecha | nical Engineering, | Focus Materials | |
| | Engineering Sciences: Compulsory | | | | |
| | General Engineering Science (German program, 7 | semester): Specialisation Mechanical E | ngineering, Focus P | roduct Developm | |
| | and Production: Compulsory | | | | |
| | General Engineering Science (German program, Compulsory | 7 semester): Specialisation Mechanica | I Engineering, Foc | us Energy Syster | |
| | General Engineering Science (German program, | 7 semester): Specialisation Mechani | cal Engineering. F | ocus Biomechani | |
| | Compulsory | | <u> </u> | | |
| | General Engineering Science (German program, 7 s General Engineering Science (German program, 7 s Compulsory | emester): Specialisation Biomedical Eng emester): Specialisation Bioprocess Eng emester): Specialisation Electrical Engir | ineering: Compulso ineering: Compulso eering: Compulsory | ory / | |
| | Computer Science: Core Qualification: Compulsory | | | | |
| | Data Science: Core Qualification: Elective Compulso | ry | | | |
| | Electrical Engineering: Core Qualification: Compulso | ry | | | |
| | General Engineering Science (English program, 7 se | | | | |
| | General Engineering Science (English program, Compulsory | 7 semester): Specialisation Mechani | cal Engineering, F | ocus Biomechan | |
| | General Engineering Science (English program, Compulsory General Engineering Science (English program, 7 | · | | | |

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

| Course L0321: Computer Eng | gineering | | |
|----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | | | |
| CP | 4 | | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | | |
| Lecturer | Prof. Heiko Falk | | |
| Language | DE/EN | | |
| 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 Eng | purse L0324: Computer Engineering | | | |
|----------------------------|---|--|--|--|
| Тур | Recitation Section (small) | | | |
| Hrs/wk | 1 | | | |
| CP | | | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | | |
| Lecturer | Heiko Falk | | | |
| Language | DE/EN | | | |
| Cycle | WiSe | | | |
| Content | See interlocking course | | | |
| Literature | See interlocking course | | | |

| Courses | | | | | |
|--|---|---|----------------------------|------------------|--|
| Title | | Тур | Hrs/wk | СР | |
| ntroduction to Physiology (L0385) | | Lecture | 2 | 3 | |
| Module Responsible | Dr. Roger Zimmermann | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | None | | | | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students ha | we reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | The students can | | | | |
| | describe the basics of the energy n | netabolism: | | | |
| | | selected fields of muscle, heart/circulation, r | neuro- and sensory physic | ology. | |
| | | | | | |
| Skills | | basic bodily functions (sensory, transmission | n and processing of inform | mation, developm | |
| D | of forces and vital functions) and relate th | iem to similar technical systems. | | | |
| Personal Competence | The students can conduct discussions in a | eccevel and medicine on a technical layer | | | |
| 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. | | | | | |
| | The students can find solutions to problem | 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 techn | | | | | |
| | themselves. | | | | |
| Workload in Hours | Independent Study Time 62, Study Time i | n Lecture 28 | | | |
| Credit points | | | | | |
| Course achievement | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and | 60 minutes | | | | |
| scale | | | | | |
| Assignment for the | General Engineering Science (German pro | gram, 7 semester): Specialisation Biomedic | al Engineering: Compulso | ory | |
| Following Curricula | General Engineering Science (German | program, 7 semester): Specialisation Me | echanical Engineering, F | ocus Biomechan | |
| | Compulsory | | | | |
| | Data Science: Specialisation Medicine: Co | mpulsory | | | |
| | Electrical Engineering: Specialisation Med | | | | |
| | Engineering Science: Specialisation Biome | | | | |
| | | program, 7 semester): Specialisation Me | chanical Engineering, F | ocus Biomechan | |
| | Compulsory | | | | |
| | General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Elective Compulsory | | | | |
| | Mechanical Engineering: Specialisation Biomechanics: Compulsory | | | | |
| | Biomedical Engineering: Specialisation Biomechanics: compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory | | | | |
| | Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory | | | | |
| | | tificial Organs and Regenerative Medicine: E | | | |
| | Biomedical Engineering: Specialisation Im | plants and Endoprostheses: Elective Compu | llsory | | |
| | Technomathematics: Specialisation III. En | gineering Science: Elective Compulsory | | | |

| Course L0385: Introduction t | ourse L0385: Introduction to Physiology | | |
|------------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| CP | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Dr. Gerhard Engler | | |
| Language | | | |
| Cycle | ie | | |
| Content | | | |
| Literature | Taschenatlas der Physiologie, Silbernagl Despopoulos, ISBN 978-3-135-67707-1, Thieme | | |
| | Repetitorium Physiologie, Speckmann, ISBN 978-3-437-42321-5, Elsevier | | |

| Courses | | | | | |
|----------------------------------|---|---|---------------------------|-------------------|--|
| Title | | Тур | Hrs/wk | СР | |
| Experimental Methods in Biomecha | nics (L0377) | Lecture | 2 | 3 | |
| Module Responsible | Prof. Michael Morlock | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | It is recommended to participate in "Imp | lantate und Frakturheilung" before attending | "Experimentelle Methode | en". | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students h | nave reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | The students can describe the different v | ways how bones heal, and the requirements f | or their existence. | | |
| | The students can name different treatme | ents for the spine and hollow bones under giv | en fracture morphologies | | |
| | The students can describe different mea | surement techniques for forces and moveme | nts and choose the adec | wate technique fo | |
| | The students can describe different measurement techniques for forces and movements, and choose the adequate technique aiven task. | | | | |
| | | | | | |
| Skills | The students can describe the basic handling of several experimental techniques used in biomechanics. | | | | |
| Personal Competence | | | | | |
| | The students can, in groups, solve basic experimental tasks. | | | | |
| | | | | | |
| Autonomy | The students can, in groups, solve basic | experimental tasks. | | | |
| Workload in Hours | Independent Study Time 62, Study Time | in Lecture 28 | | | |
| Credit points | 3 | | | | |
| Course achievement | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and | 90 min | | | | |
| scale | | | | | |
| Assignment for the | General Engineering Science (German | program, 7 semester): Specialisation Me | chanical Engineering, F | ocus Biomechan | |
| Following Curricula | Compulsory | | | | |
| | General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory | | | | |
| | Engineering Science: Specialisation Biomedical Engineering: Elective Compulsory | | | | |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics | | | | |
| | Compulsory | | | | |
| | | ogram, 7 semester): Specialisation Biomedica | | - | |
| | | ogram, 7 semester): Specialisation Biomedica | I Engineering: Elective C | ompulsory | |
| | Mechanical Engineering: Specialisation B Technomathematics: Specialisation III. E | | | | |

| Course L0377: Experimental | 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 | | |

| Module M0934: Advai | and Materials | | | | |
|--|--|--|-----------------------|-----------------|--|
| | | | | | |
| Courses | | | | | |
| Title | | Тур | Hrs/wk | СР | |
| Advanced Materials Characterizatio | n (L1087) | Lecture | 2 | 2 | |
| Advanced Materials Design (L1091) | | Lecture | 2 | 2 | |
| Advanced Materials Design (L1092) | | Recitation Section (large) | 2 | 2 | |
| Module Responsible | Prof. Patrick Huber | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Fundamentals of Materials Science (I and II) |) | | | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students hav | e reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | The students will be able to explain the properties of advanced materials along with their applications in technology, in particula metallic, ceramic, polymeric, semiconductor, modern composite materials (biomaterials) and nanomaterials. | | | | |
| Skills | The students will be able to select material configurations according to the technical needs and, if necessary, to design ne materials considering architectural principles from the micro- to the macroscale. The students will also gain an overview or modern materials science, which enables them to select optimum materials combinations depending on the technical application | | | | |
| Personal Competence Social Competence | The students are able to present solutions to specialists and to develop ideas further. | | | | |
| Autonomy | The students are able to | | | | |
| | assess their own strengths and weak | knesses. | | | |
| | define tasks independently. | | | | |
| Workload in Hours | Independent Study Time 96, Study Time in | Lecture 84 | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and | 90 min | | | | |
| scale | | | | | |
| Assignment for the | General Engineering Science (German p | program, 7 semester): Specialisation Mecha | nical Engineering, F | ocus Biomechani | |
| Following Curricula | | | 5 5, | | |
| - | | program, 7 semester): Specialisation Mech | anical Engineering, | Focus Materials | |
| | Engineering Sciences: Compulsory | | | | |
| | Data Science: Specialisation Materials Scien | nce: Compulsory | | | |
| | General Engineering Science (English progr | ram, 7 semester): Specialisation Mechanical En | gineering: Elective C | Compulsory | |
| | Mechanical Engineering: Core Qualification: | | | | |

| ourse 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: Advanced Ma | 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. Patrick Huber, Prof. Stefan Fritz Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller | | |
| Language | DE/EN | | |
| Cycle | SoSe | | |
| Content | | | |
| Literature | Verlegungenskerlegen | | |
| Literature | Vorlesungsunterlagen | | |

| Course L1092: Advanced Ma | ourse 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 Fritz Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller | | |
| Language | DE/EN | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

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.

| - | | | | | |
|--|---|--|--------------------|---------------------|--|
| Courses | | | | | |
| Title | | Тур | Hrs/wk | СР | |
| Computer Engineering (L0321) Computer Engineering (L0324) | | Lecture Recitation Section (small) | 3 1 | 4 | |
| Module Responsible | Prof Hoiko Falk | Accitation Section (Sinally | 1 | L | |
| Admission Requirements | | | | | |
| - | Basic knowledge in electrical engineering | | | | |
| Knowledge | basic knowledge in electrical engineering | | | | |
| Educational Objectives | After taking part successfully, students have reache | d the following learning results | | | |
| Professional Competence | ······ | | | | |
| - | This module deals with the foundations of the fun | ctionality of computing systems. It cover | s the lavers fron | n the assembly-lev | |
| | programming down to gates. The module includes t | | | | |
| | Introduction | | | | |
| | Combinational logic: Gates, Boolean algebra, | Boolean functions hardware synthesis of | mbinational net | works | |
| | Sequential logic: Flip-flops, automata, system | | | | |
| | Technological foundations | 5 | | | |
| | Computer arithmetic: Integer addition, subtra | action, multiplication and division | | | |
| | Basics of computer architecture: Programmin | g 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-p | oint connections, | busses | |
| Skills | The students perceive computer systems from the a | architect's perspective, i.e., they identify t | he internal struct | ture and the physic | |
| | composition of computer systems. The students can analyze, how highly specific and individual computers can be built b | | | | |
| | collection of few and simple components. They are | able to distinguish between and to expla | ain the different | abstraction layers | |
| | today's computing systems - from gates and circuits | s up to complete processors. | | | |
| | After successful completion of the module, the stu | idents are able to judge the interdepend | encies between | a physical comput | |
| | system and the software executed on it. In particul | | | | |
| | on the hardware-centric abstraction layers from the | | | | |
| | the impact that these low abstraction levels have or | | | | |
| Deveenel Commetence | | | | | |
| Personal Competence | Students are able to solve similar problems alone or | in a group and to procent the results acc | ordinaly | | |
| Social competence | Students are able to solve similar problems alone of | in a group and to present the results act | orunigiy. | | |
| Autonomy | Students are able to acquire new knowledge from s | pecific literature and to associate this know | wledge with othe | r classes. | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture | 2 56 | | | |
| Credit points | 6 | | | | |
| Course achievement | | Description | | | |
| | Yes 10 % Excercises | | | | |
| Examination | | | | | |
| | 90 minutes, contents of course and labs | | | | |
| scale | | | | | |
| Assignment for the | | | | | |
| Following Curricula | General Engineering Science (German program, 7 s | | . . | or y | |
| | General Engineering Science (German program, 7 s General Engineering Science (German program, 7 s | | | 1 | |
| | | | | | |
| | 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 s | | - | 5 | |
| | General Engineering Science (German program, | | 5 1 5 | Focus Mechatronic | |
| | Compulsory | | 2 5, | | |
| | General Engineering Science (German program, | 7 semester): Specialisation Mechanica | l Engineering, F | ocus Biomechanic | |
| | Compulsory | | | | |
| | General Engineering Science (German program, | 7 semester): Specialisation Mechanical | Engineering, Foo | us Aircraft System | |
| | Engineering: Compulsory | | | | |
| | General Engineering Science (German program, | 7 semester): Specialisation Mechanic | al Engineering, | Focus Materials | |
| | | | | | |

| 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 |
| General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: Compulsory |
| General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory |
| Computer Science: Core Qualification: Compulsory |
| Data Science: Core Qualification: Elective Compulsory |
| Electrical Engineering: Core Qualification: Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Civil 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 Computer Science: 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 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 Naval Architecture: Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory |
| Computational Science and Engineering: Core Qualification: Compulsory |
| Mechatronics: Core Qualification: Compulsory |
| Technomathematics: Specialisation II. Informatics: Elective Compulsory |
| |

| Course L0321: Computer Eng | jineering |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Heiko Falk |
| Language | DE/EN |
| 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 Eng | ourse L0324: Computer Engineering | |
|----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE/EN | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|--------------------------|---|--|----------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Heat Transfer (L0458) | | Lecture | 3 | 4 |
| Heat Transfer (L0459) | | Recitation Section (large) | 2 | 2 |
| Module Responsible | Dr. Andreas Moschallski | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Technical Thermodynamics I, II and Fluid Dynamics | | | |
| Knowledge | After taking part successfully, students have reached th | following loorning results | | |
| Professional Competence | After taking part successfully, students have reached the | rollowing learning results | | |
| - | The students are able to | | | |
| | - describe the different physical mechanism of Heat Trar | sfer, | | |
| | - explain the technical terms, | | | |
| | - to analyse comlex heat transfer processes in a critical v | vay. | | |
| Skills | The students are able to | | | |
| | - understand the physics of Heat Transfer, | | | |
| | - calculate and evaluate complex Heat Transfer processe | S, | | |
| | - solve excersises self-consistent and in small groups. | | | |
| Personal Competence | | | | |
| Social Competence | The students are able to discuss in small groups and dev | elop an approach. | | |
| Autonomy | The students are able to develop a complex problem se | f-consistent and analyse the results i | in a critical way. A | A qualified exchar |
| | with other students is given. | ····· | , | 1 |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 min | | | |
| scale | | | | |
| | General Engineering Science (German program, 7 se | mester): Specialisation Mechanical | Engineering, Foc | us Energy System |
| Following Curricula | Compulsory | | | |
| | General Engineering Science (German program, 7 semes | | | |
| | General Engineering Science (German program, 7 seme | ster): Specialisation Mechanical Engi | neering, Focus Th | eoretical Mechani |
| | Engineering: Compulsory | | | |
| | Energy Systems: Technical Complementary Course Core | Studies: Elective Compulsory | | |
| | General Engineering Science (English program, 7 ser | nester): Specialisation Mechanical | Engineering, Foc | us Energy Syste |
| | Compulsory | | | |
| | General Engineering Science (English program, 7 semes | er): Specialisation Biomedical Engine | eering: Compulso | ry |
| | Mechanical Engineering: Specialisation Energy Systems: | Compulsory | | |
| | Mechanical Engineering: Specialisation Theoretical Mech | anical Engineering: Elective Compuls | orv | |

| Course L0458: Heat Transfer | | | |
|-----------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 3 | | |
| CP | 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 (steady and unsteady), Convective Heat Transfer (natural convection, forced convection), | | |
| | Two-phase Heat Transfer (evaporation, condensation), Thermal Radiation, Heat Transfer on a thermodynamic view, | | |
| | thermotechnical devices, measures of temperature and heat flux | | |
| | | | |
| | | | |
| Literature | - Herwig, H.; Moschallski, A.: Wärmeübertragung, 4. Auflage, Springer Vieweg Verlag, Wiesbaden, 2019 | | |
| | - 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 | ourse L0459: Heat Transfer | |
|-----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| CP | 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 | | Тур | Hrs/wk | СР | |
| | ines and Turbomachinery - Part Reciprocating Engines (L0633) | Lecture | 1 | 1 | |
| | ines and Turbomachinery - Part Reciprocating Engines (L0634) | Recitation Section (large) | 1 | 1 | |
| Internal Combustion Engines I (L00 | | Lecture Recitation Section (large) | 2 | 2 2 | |
| Internal Combustion Engines I (L06 | | Recitation Section (large) | T | Z | |
| Module Responsible | Prof. Christopher Friedrich Wirz | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Thermodynamics, Mechanics, Machine Elements | | | | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students have reached the follo | owing learning results | | | |
| Professional Competence | | | | | |
| Knowledge | As a result of the part module "Fundamentals of Reciprocatin | g Machinery", the students are a | able to reflect fur | damentals regardi | |
| | power and working machinery and describe the qualitative a | and quantitative correlations of o | operating method | is and efficiencies | |
| | multiple types of engines, compressors and pumps. They a | re able to utilize technical term | s and parameter | s as well as aspec | |
| | regarding the development of power density and efficience | y, furthermore to give an over | view of charging | systems, fuels a | |
| | emissions. The students are able to select specific types of m | achinery and assess design rela | ted and operation | nal problems. | |
| | As a result of the part module "Internal Combustion Engi | nos I" the students are able r | aflact and utilize | the state of the a | |
| | | | | | |
| | 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. | | | | |
| | becalled knowledge is present regarding computer-aided pro | cess design. | | | |
| Skills | s The students are skilled to employ basic and detail knowledge regarding reciprocating machinery, their selection and operatior | | | | |
| | They are further able to assess, analyse and solve technical and operational problems and to perform mechanical an | | | | |
| | thermodynamic design. | | | | |
| | | | | | |
| | | | | | |
| Personal Competence | | | | | |
| Social Competence | The students are able to communicate and cooperate in | a professional environment in | the field of ma | achinery design a | |
| , | application. | | | , , | |
| | | | | | |
| | | | | | |
| Autonomy | The widespread scope of gained knowledge enables the stud | lents to handle situations in thei | r future professio | n independently a | |
| Autonomy | The widespread scope of gained knowledge enables the students to handle situations in their future profession independently and confidently. | | | | |
| | connectity. | | | | |
| | | | | | |
| Werkland in Heure | Independent Study Time 110 Study Time in Lecture 70 | | | | |
| | Independent Study Time 110, Study Time in Lecture 70 | | | | |
| Credit points | | | | | |
| Course achievement | | | | | |
| Examination | Written exam | | | | |
| Examination duration and | 120 min | | | | |
| scale | | | | | |
| Assignment for the | General Engineering Science (German program, 7 semest | er): Specialisation Mechanical | Engineering, Foc | us Energy System | |
| Following Curricula | Compulsory | | | | |
| | Energy and Environmental Engineering: Core Qualification: El | lective Compulsory | | | |
| | Energy Systems: Technical Complementary Course Core Stud | lies: Elective Compulsory | | | |
| | General Engineering Science (English program, 7 semester | er): Specialisation Mechanical I | Engineering, Foc | us Energy System | |
| | Compulsory | | | | |
| | Green Technologies: Energy, Water, Climate: Specialisation E | nergy Technology: Elective Com | pulsory | | |
| | Mechanical Engineering: Specialisation Energy Systems: Com | and a second | | | |

| Тур | Lecture |
|------------|--|
| Hrs/wk | 1 |
| CP | 1 |
| | Independent Study Time 16, Study Time in Lecture 14 |
| | Prof. Christopher Friedrich Wirz |
| Language | |
| Cycle | |
| 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 Drinzin der Kelhenpumpen |
| | Prinzip der Kolbenpumpen Finfeilung und Verwendung |
| | Einteilung und Verwendung |
| Literature | A. Urlaub: Verbrennungsmotoren |

| ourse L0634: Fundamentals of Reciprocating Engines and Turbomachinery - Part Reciprocating Engines | | |
|--|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | 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 Comb | oustion Engines I |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 Comb | ourse L0639: Internal Combustion Engines I | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| CP | 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 | | |

| Courses | | | | | |
|--|---|--|--------------------|------------------|--|
| Title | | Turn | Hre /wk | СР | |
| | | Typ Lecture | Hrs/wk 2 | 2 | |
| Advanced Mechanical Engineering I Advanced Mechanical Engineering I | | Recitation Section (large) | 2 | 1 | |
| Advanced Mechanical Engineering I | | Lecture | 2 | 2 | |
| Advanced Mechanical Engineering I | - | Recitation Section (large) | 2 | 1 | |
| Module Responsible | | | | | |
| Admission Requirements | | | | | |
| Recommended Previous | | | | | |
| Knowledge | Fundamentals of Mechanical Engineering | g Design | | | |
| Kilowieuge | Mechanics | | | | |
| | Fundamentals of Materials Science | | | | |
| | Production Engineering | | | | |
| | | | | | |
| | After taking part successfully, students have re | ached 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 ele | ements of fluidics | , | |
| | explain requirements, selection criteria, | application scenarios and practical examples | of complex machi | ine elements, | |
| | indicate the background of dimensioning | calculations. | | | |
| Skills | After passing the module, students are able to: | | | | |
| | accomplich dimensioning calculations of covered machine elements | | | | |
| | accomplish dimensioning calculations of covered machine elements, transfer knowledge learned in the module to new requirements and tasks (problem solving skills), | | | | |
| | | | iving skills), | | |
| | recognize the content of technical drawings and schematic sketches, | | | | |
| | evaluate complex designs, technically. | | | | |
| Personal Competence | | | | | |
| Social Competence | | | | | |
| Social competence | Students are able to discuss technical in | formation in the lecture supported by activating | ng methods. | | |
| Autonomi | | | | | |
| 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 vid | | | | |
| | recordings of the lectures. | | | | |
| | | | | | |
| Workload in Hours | Independent Study Time 68, Study Time in Lec | ture 112 | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | | | | | |
| Examination duration and | 120 | | | | |
| scale | | | | | |
| - | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering: Compulsory | | | | |
| Following Curricula | a General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems | | | | |
| | Compulsory | | | | |
| | Energy and Environmental Engineering: Core Q | ualification: Elective Compulsory | | | |
| | Energy Systems: Technical Complementary Con | urse Core Studies: Elective Compulsory | | | |
| | Engineering Science: Specialisation Mechanical | Engineering: Compulsory | | | |
| | General Engineering Science (English program, | 7 semester): Specialisation Mechanical Engin | eering: Compulso | ry | |
| | General Engineering Science (English progra | m, 7 semester): Specialisation Mechanical | Engineering, Foc | us Energy Syster | |
| | Scherdi Engliseering Science (English produ | | | | |
| | Compulsory | | 5 5. | 5,7 , | |
| | | | 5 5. | 5, , | |

| Course L0264: Advanced Med | chanical Engineering Design II |
|----------------------------|---|
| | |
| Hrs/wk | 2 |
| CP | 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 |
| | Gear drives |
| | • Epicyclic gears |
| | Crank gears |
| | Sliding bearings Calculations of hydrostatic systems (fluidics) |
| | • Calculations of hydrostatic systems (induce) |
| Literature | Dubbal Teachadach für den Marshinghau Crobe IV. L. Feldburge L(Uner). Gedaren Verlag, alter H. A. flage |
| | Dubbel, Taschenbuch f ür 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 L0265: Advanced Me | 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 | |

| se L0262: Advanced Me | chanical Engineering Design I |
|-----------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 |
| 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 |
| | • Gear drives |
| | • Epicyclic gears |
| | Crank gears |
| | Sliding bearings Calculations of hydrostatic systems (fluidics) |
| | - concurations of hydroscolic systems (nonics) |
| Literature | Dubbal Taschaphuch für den Maschinaphaus Crote K. H. Feldhusen I. (Hrsg.): Springer Verlag, aktuelle Auflage |
| | Dubbel, Taschenbuch f ür 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, aktuel |
| | Auflage. |
| | Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. |
| | Sowie weitere Bücher zu speziellen Themen |

| Course L0263: Advanced Me | Course L0263: Advanced Mechanical Engineering Design I | |
|---------------------------|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | | |
| 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 | | Tun | Hrs/wk | СР |
| Computational Fluid Dynamics I (L | 235) | Typ Lecture | 2 | 3 |
| Computational Fluid Dynamics I (LC | | Recitation Section (large) | 2 | 3 |
| Module Responsible | Prof. Thomas Rung | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | Mathematical Methods for Engineers | | | |
| | Fundamentals of Differential/integral cale | culus and series expansions | | |
| Educational Objectives | After taking part successfully, students have re- | ached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are able to list the basic numerics | of partial differential equations. | | |
| | | | | |
| | | | | |
| Skills | The students are able develop appropriate num | nerical integration in space and time for the g | overning partial d | lifferential equatio |
| | They can code computational algorithms in a st | ructured way. | | |
| | | | | |
| | | | | |
| | | | | |
| Borconal Compotonco | | | | |
| Personal Competence | The students can arrive at work results in group | as and document them | | |
| Social Competence | The students can arrive at work results in group | ss and document them. | | |
| | | | | |
| Automore | The students can independently applying approx | a character and sing an a sific problems | | |
| Autonomy | The students can independently analyse approa | aches to solving specific problems. | | |
| | | | | |
| | | | | |
| | | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lee | cture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 2h | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program | n, 7 semester): Specialisation Mechanical Engi | neering, Focus Th | neoretical Mechani |
| Following Curricula | Engineering: Elective Compulsory | | | |
| | General Engineering Science (German progra | am, 7 semester): Specialisation Mechanical | Engineering, Foo | us Aircraft Syste |
| | Engineering: Elective Compulsory | | | |
| | General Engineering Science (German progra | am, 7 semester): Specialisation Mechanical | Engineering, Foc | us Energy Syster |
| | Elective Compulsory | | | |
| | General Engineering Science (German program | | | |
| | General Engineering Science (German program | | romental Enginee | ring: Compulsory |
| | Energy Systems: Technical Complementary Cou General Engineering Science (English program, | | omental Engineer | ing: Compulsory |
| | General Engineering Science (English program, General Engineering Science (English program) | | - | |
| | Elective Compulsory | , , semester, specialisation methallical | Lighteening, 100 | as Energy Syster |
| | General Engineering Science (English program, | 7 semester): Specialisation Naval Architectur | e: Compulsory | |
| | General Engineering Science (English program, General Engineering Science (English program) | | | us Aircraft Syste |
| | Engineering: Elective Compulsory | ,,, | | |
| | Mechanical Engineering: Specialisation Energy | Systems: Elective Compulsory | | |
| | | | | |
| | Mechanical Engineering: Specialisation Aircraft | Systems Engineering: Elective Compulsory | | |
| | Mechanical Engineering: Specialisation Aircraft Naval Architecture: Core Qualification: Compuls | | | |

| Course L0235: Computationa | al Fluid Dynamics I | |
|----------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| CP | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Thomas Rung | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Cycle Wise Content Fundamentals of computational modelling of thermofluid dynamic problems. Development of numerical algorithms. 1. Partial differential equations 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 10. Basics of grid generation | |
| Literature | Ferziger and Peric: Computational Methods for Fluid Dynamics, Springer | |

| Course L0419: Computationa | urse 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 |
| Numerical Mathematics I (L0417) | | Lecture | 2 | 3 |
| Numerical Mathematics I (L0418) | | Recitation Section (small) | 2 | 3 |
| Module Responsible | Prof. Sabine Le Borne | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mathematik I + II for Engineering Students (g) | erman or english) or Analysis & Linear Ald | aebra I + II for Te | chnomathematic |
| Knowledge | basic MATLAB/Python knowledge | | | |
| | | | | |
| - | After taking part successfully, students have reache | d the following learning results | | |
| Professional Competence | Students are able to | | | |
| Knowledge | Students are able to | | | |
| | name numerical methods for interpolation, in | ntegration, least squares problems, eigenv | value problems, r | onlinear root fin |
| | problems and to explain their core ideas, | | | |
| | repeat convergence statements for the nume | | | |
| | explain aspects for the practical execution of | numerical methods with respect to compo | utational and stor | rage complexitx. |
| | | | | |
| | | | | |
| Skills | Students are able to | | | |
| | implement, apply and compare numerical me | ethods using MATLAB/Python, | | |
| | justify the convergence behaviour of numeric | al methods with respect to the problem a | nd solution algori | thm, |
| | select and execute a suitable solution approx | ch for a given problem. | | |
| Personal Competence | | | | |
| • | Students are able to | | | |
| boelar competence | | | | |
| | work together in heterogeneously composed | teams (i.e., teams from different study pr | ograms and bac | kground knowled |
| | explain theoretical foundations and support e | each other with practical aspects regarding | g the implementa | tion of algorithm |
| Autonomv | Students are capable | | | |
| , | | | | |
| | to assess whether the supporting theoretical | | individually or in | i a team, |
| | to assess their individual progess and, if nece | essary, to ask questions and seek help. | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture | 2 56 | | |
| Credit points | | | | |
| Course achievement | | | | |
| | Written exam | | | |
| Examination duration and | | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 s | emester): Specialisation Computer Science | e: Compulsory | |
| | General Engineering Science (German program | | | Focus Material |
| | Engineering Sciences: Compulsory | | | |
| | General Engineering Science (German program, 7 s | emester): Specialisation Biomedical Engin | eering: Compulso | ory |
| | General Engineering Science (German program, | 7 semester): Specialisation Mechanica | l Engineering, F | ocus Biomecha |
| | Compulsory | | | |
| | General Engineering Science (German program, 7 s | emester): Specialisation Mechanical Engir | neering, Focus Th | eoretical Mecha |
| | Engineering: Compulsory | | | |
| | General Engineering Science (German program, | / semester): Specialisation Mechanical | Engineering, Foc | us Aircraft Syst |
| | Engineering: Elective Compulsory General Engineering Science (German program, 7 s | omostor), Specialization Machanical Franci | pooring Ecours | ochatronica: El- |
| | General Fugureeung Science German program 7 / | emester: specialisation Mechanical Engli | ieening, rocus M | |
| | | | | echacionics. Liet |
| | Compulsory | | Engineering Foc | |
| | Compulsory General Engineering Science (German program, | | Engineering, Foc | |
| | Compulsory General Engineering Science (German program, Elective Compulsory | 7 semester): Specialisation Mechanical I | | |
| | Compulsory General Engineering Science (German program, | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso | | |
| | Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory | iry | |
| | Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory | iry | |
| | Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics and | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso | iry | |
| | Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory | iry | |
| | Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory | iry | |
| | Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory | iry | |
| | Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science | ry pry : Compulsory | us Energy Syste |
| | Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science | ry pry : Compulsory | us Energy Syste |
| | Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, Compulsory | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical | ory ory : Compulsory Engineering, F | us Energy Syste ocus Biomechae |
| | Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical | ory ory : Compulsory Engineering, F | us Energy Syste ocus Biomechae |
| | Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se Sciences: Compulsory | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine | ory ory Compulsory Engineering, F eering, Focus Mat | us Energy Syste ocus Biomechai erials in Enginee |
| | Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine | ory ory Compulsory Engineering, F eering, Focus Mat | us Energy Syste ocus Biomechai erials in Enginee |
| | Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se Sciences: Compulsory | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical Engine emester): Specialisation Mechanical Engine | ory : Compulsory Engineering, F eering, Focus Mat eering, Focus Th | us Energy Syste ocus Biomechai erials in Enginee eoretical Mechai |
| | Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General I Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory ad Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine emester): Specialisation Mechanical Engine | ory : Compulsory Engineering, F eering, Focus Mat eering, Focus Th eering: Compulso | us Energy Syste ocus Biomechai erials in Enginee eoretical Mechai |

Computational Science and Engineering: Core Qualification: Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Mechanical Engineering: Specialisation Mechatronics: Elective Compulsory

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

Process Engineering: Specialisation Process Engineering: Elective Compulsory

| Course L0417: Numerical Ma | Course L0417: Numerical Mathematics I | | |
|----------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | | | |
| CP | | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Sabine Le Borne | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss quadrature, adaptive quadrature | | |
| Literature | Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer | | |

| Course L0418: Numerical Ma | urse L0418: Numerical Mathematics I | |
|----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| CP | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Sabine Le Borne, Dr. Jens-Peter Zemke | |
| Language | EN | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|-------------------------------------|--|--|----------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Electrical Machines and Actuators (| L0293) | Lecture | 3 | 4 |
| Electrical Machines and Actuators (| L0294) | Recitation Section (large) | 2 | 2 |
| Module Responsible | Prof. Thorsten Kern | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basics of mathematics, in particular comp | exe numbers, integrals, differentials | | |
| Knowledge | Basics of electrical engineering and mecha | anical engineering | | |
| Educational Objectives | After taking part successfully, students ha | ve reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students can to draw and explain the basi | c principles of electric and magnetic fields. | | |
| | They can describe the function of the | standard turnes of clastic machines and pro | cont the correspond | dina aquationa a |
| | - | standard types of electric machines and pre ives they can explain the major parameters of th | | |
| | from the power grid to the driven engine. | ives they can explain the major parameters of th | le energy enterency | of the whole syste |
| | | | | |
| Skills | Students are able to calculate two-dimen | sional electric and magnetic fields in particular | ferromagnetic circu | uits with air gap. |
| | this they apply the usual methods of the d | esign auf electric machines. | | |
| | They can calulate the operational perform | nance of electric machines from their given cha | racteristic data and | d selected quantit |
| | | usual equivalent circuits and graphical methods. | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | none | | | |
| Autonomy | Students are able independently to calcul | ate electric and magnatic fields for applications. | They are able to ar | nalyse independer |
| | nomy Students are able independently to calculate electric and magnatic fields for applications. They are able to analyse the operational performance of electric machines from the charactersitic data and theycan calculate thereof selected and the operational performance of electric machines from the charactersitic data and they are able to analyse the operational performance of electric machines from the charactersitic data and they are able to analyse the operational performance of electric machines from the charactersitic data and they are able to analyse the operational performance of electric machines from the charactersitic data and they are able to analyse the operational performance of electric machines from the charactersitic data and they are able to analyse the operational performance of electric machines from the charactersitic data and they are able to analyse the operational performance of electric machines from the charactersitic data and they are able to analyse the operational performance of electric machines from the charactersitic data and they are able to analyse the operational performance of electric machines from the charactersitic data and they are able to analyze the operational performance of electric machines from the charactersitic data and they are able to analyze the operational performance of electric machines from the charactersitic data and they are able to analyze the operational performance of electric machines from the charactersitic data and they are able to analyze the operational performance of electric machines from the charactersitic data and they are able to analyze the operational performance of electric machines from the charactersitic data and they are able to analyze the operational performance of electric machines from the charactersitic data and they are able to analyze the operational performance of electric machines from the charactersitic data and they are able to analyze the operational performance of electric machines from the operational performance of electr | | | f selected quantit |
| | and characteristic curves. | | | |
| | | | | |
| | | | | |
| Workload in Hours | Independent Study Time 110, Study Time | in Lecture 70 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Subject theoretical and practical work | | | |
| Examination duration and | Design of four machines and actuators, re- | view of design files | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German pro | gram, 7 semester): Specialisation Electrical Engi | neering: Elective Co | mpulsory |
| Following Curricula | General Engineering Science (German p | rogram, 7 semester): Specialisation Mechanica | al Engineering, Foc | us Energy Syster |
| | Compulsory | | | |
| | | program, 7 semester): Specialisation Mechan | ical Engineering, I | Focus Mechatron |
| | Compulsory | gram, 7 semester): Specialisation Mechanical En | ginopring Focus Th | anatical Machani |
| | Engineering: Elective Compulsory | gram, 7 semester). Specialisation Mechanical En | gineering, rocus ri | |
| | Digital Mechanical Engineering: Core Qual | fication: Compulsory | | |
| | Electrical Engineering: Core Qualification: | | | |
| | Energy and Environmental Engineering: Co | | | |
| | General Engineering Science (English prog | ram, 7 semester): Specialisation Mechanical Eng | ineering: Elective C | ompulsory |
| | Green Technologies: Energy, Water, Clima | te: Specialisation Energy Technology: Elective Co | ompulsory | |
| | Logistics and Mobility: Specialisation Engir | eering Science: Elective Compulsory | | |
| | 5 , 1 | c Planning and Systems: Elective Compulsory | | |
| | | uction Management and Processes: Elective Com | pulsory | |
| | Mechanical Engineering: Core Qualification | | | |
| | Mechatronics: Core Qualification: Compuls | • | | |
| | Technomathematics: Specialisation III. Eng | ineering Science: Elective Compulsory | | |
| | | | | |
| | Engineering and Management - Major in Lo | ogistics and Mobility: Specialisation Traffic Planni Logistics and Mobility: Specialisation Productio | | |

| Course L0293: Electrical Mac | hines and Actuators |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Thorsten Kern, Dennis Kähler |
| Language | DE |
| Cycle | SoSe |
| Content | Electric field: Coulomb's law, flux (field) line, work, potential, capacitor, energy, force, capacitive actuators |
| | Magnetic field: force, flux line, Ampere's law, field at bounderies, flux, magnetic circuit, hysteresis, induction, self-induction, mutual inductance, transformer, electromagnetic actuators |
| | Synchronous machines, construction and layout, equivalent single line diagrams, no-load and short-cuircuit characteristics, vector diagrams, motor and generator operation, stepper motors |
| | 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 (squirrel-cage vs. sliprings), |
| | Drives with variable speed, inverter fed operation, special drives |
| 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 and Actuators | |
|---|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Thorsten Kern, Dennis Kähler |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Courses | | | | |
|--|--|---|--------------------------------------|---------------------------------------|
| Title | | Тур | Hrs/wk | СР |
| Power Industry (L0316) | | Lecture | 1 | 1 |
| Energy Systems and Energy Industry (L0315) Renewable Energy (L0313) | | Lecture Lecture | 2 | 2 2 |
| Renewable Energy (L1434) | | Recitation Section (small) | 1 | 1 |
| | Prof. Martin Kaltschmitt | | | |
| • | None | | | |
| Recommended Previous | none | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached | d the following learning results | | |
| Professional Competence | | | | |
| Knowledge | With completion of this module, the students can p efficiency. They can explain the issues occurring in th distribution and power trading wih regard to sub applicable to many energy systems in general, esp the students can explain the environmental benefits | his context. Furthermore, they can explai oject-related contexts. The students ca ecially for renewable energy systems an | n details of powe n explain these | r generation, pow aspects, which a |
| | Students are able to apply methodologies for detailed determination of energy demand or energy production for various types energy systems. Furthermore, they can evaluate energy systems technically, environmentally and economically and design the under certain given conditions. Therefore, they can choose the necessary subject-specific calculation rules, also for r standardized solutions of a problem. The students are able to explain questions and possible approaches to its processing from the field of renewable energies or and to put them them into the right context. | | | |
| Personal Competence | | | | |
| | The students are able to analyze suitable technica criteria under sustainability aspects. This allows then | | | |
| Autonomy | Students can independently exploit sources , acqui questions. | ire the particular knowledge about the s | subject area and | transform it to n |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 8 | 34 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 3 hours written exam | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 se | emester): Specialisation Process Engineer | ing: Compulsory | |
| Following Curricula | General Engineering Science (German program, 7 se | emester): Specialisation Process Engineer | ing: Compulsory | |
| | General Engineering Science (German program, 7 | semester): Specialisation Mechanical | Engineering, Foc | us Energy Syster |
| | Elective Compulsory | Civil Engineering: Elective Course? | | |
| | Civil- and Environmental Engineering: Specialisation | | | |
| | Civil- and Environmental Engineering: Specialisation | iramic and Mobility: Elective Compulsory | | |
| | Chill and Environmental Environmental Control Post | Water and Environment Election C | leen | |
| | Civil- and Environmental Engineering: Specialisation Energy and Environmental Engineering: Core Qualific | | lsory | |

| Course L0316: Power Industr | y |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 1 |
| CP | 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 e-mobility)) 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 |
| Literature | Folien der Vorlesung |

| Course L0315: Energy System | ns and Energy Industry |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 Er | nergy |
|----------------------------|---|
| 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 - Systemtechnik, Wirtschaftlichkeit, 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: Renewable Er | nergy |
|----------------------------|--|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| CP | 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 - Systemtechnik, Wirtschaftlichkeit, 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.

| Courses | | | | |
|--|---|---|---------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Advanced Mechanical Engineering | | Lecture | 2 | 2 |
| Advanced Mechanical Engineering | | Recitation Section (large) | 2 | 1 |
| Advanced Mechanical Engineering Advanced Mechanical Engineering | | Lecture Recitation Section (large) | 2 | 2 1 |
| | | Reclation Section (large) | 2 | 1 |
| Module Responsible | | | | |
| Admission Requirements Recommended Previous | | | | |
| Knowledge | Eundamentals of Mechanical Engineering | ng Design | | |
| Riomeuge | Mechanics | | | |
| | Fundamentals of Materials Science | | | |
| | Production Engineering | | | |
| Educational Objectives | After taking part successfully, students have i | reached the following learning results | | |
| Professional Competence | | | | |
| - | After passing the module, students are able to | 0: | | |
| | ······ | | | |
| | | d functions of machine elements and of basic e | | |
| | | a, application scenarios and practical examples | of complex maching | ine elements, |
| | indicate the background of dimensionir | ig calculations. | | |
| Skills | After passing the module, students are able to | 0: | | |
| | - commist dimensioning coloulations | of covered machine elements | | |
| | accomplish dimensioning calculations of transfer knowledge learned in the mod | | lving skills) | |
| | transfer knowledge learned in the mod recognize the content of technical draw | lule to new requirements and tasks (problem so wings and schematic sketches | Jiving skins), | |
| | recognize the content of technical draw evaluate complex designs, technically. | | | |
| | • evaluate complex designs, technicary. | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to discuss technical. | information in the lecture supported by activati | ing methods | |
| | • Students are able to discuss technicari | mornation in the lecture supported by activat | ing methods. | |
| Autonomy | , • Students are able to independently dev | epen their acquired knowledge in exercises. | | |
| | | al knowledge and to recapitulate poorly under | rstood content e c | , by using the vi |
| | recordings of the lectures. | in knowledge and to recupitalate poorly ander | stobu content e.g | . by using the vi |
| | | | | |
| Workload in Hours | Independent Study Time 68, Study Time in Le | cture 112 | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German progra | m, 7 semester): Specialisation Mechanical Engi | ineering: Compuls | ory |
| Following Curricula | General Engineering Science (German pro | gram, 7 semester): Specialisation Mechanic | al Engineering, I | Focus Biomechan |
| | Compulsory | | Facility of the Fac | E |
| | | gram, 7 semester): Specialisation Mechanical | Engineering, Foo | us Energy System |
| | Compulsory | gram, 7 semester): Specialisation Mechanical | Engineering Eq | aug Aircraft Syste |
| | Engineering: Compulsory | ian, 7 semester, specialisation mechanical | Lingineering, 100 | Lus Anciait Syste |
| | | ogram, 7 semester): Specialisation Mechan | ical Engineering | Focus Materials |
| | Engineering Sciences: Compulsory | ygrani, / Schester, Specialisation reenali | icai zrigineering, | |
| | | gram, 7 semester): Specialisation Mechanic | al Engineering, | Focus Mechatron |
| | Compulsory | 5 | 5 5. | |
| | General Engineering Science (German progra | am, 7 semester): Specialisation Mechanical En | gineering, Focus F | Product Developm |
| | and Production: Compulsory | | | |
| | General Engineering Science (German progra | m, 7 semester): Specialisation Mechanical Eng | ineering, Focus Th | neoretical Mechan |
| | | | | |
| | Engineering: Compulsory | | | |
| | Engineering: Compulsory Energy Systems: Technical Complementary C | ourse Core Studies: Elective Compulsory | | |
| | | | | |
| | Energy Systems: Technical Complementary C Engineering Science: Specialisation Mechanic | | neering: Compulso | pry |
| | Energy Systems: Technical Complementary C Engineering Science: Specialisation Mechanic General Engineering Science (English program | al Engineering: Compulsory | ÷ . | - |
| | Energy Systems: Technical Complementary C Engineering Science: Specialisation Mechanic General Engineering Science (English program General Engineering Science (English prog Compulsory | al Engineering: Compulsory n, 7 semester): Specialisation Mechanical Engir gram, 7 semester): Specialisation Mechanic | al Engineering, F | Focus Biomechan |
| | Energy Systems: Technical Complementary C Engineering Science: Specialisation Mechanic General Engineering Science (English program General Engineering Science (English progr Compulsory General Engineering Science (English progr | al Engineering: Compulsory n, 7 semester): Specialisation Mechanical Engir | al Engineering, F | Focus Biomechar |
| | Energy Systems: Technical Complementary C Engineering Science: Specialisation Mechanic General Engineering Science (English progran General Engineering Science (English progr Compulsory General Engineering Science (English progr Compulsory | al Engineering: Compulsory n, 7 semester): Specialisation Mechanical Engir gram, 7 semester): Specialisation Mechanic | al Engineering, F | Focus Biomechar |

| 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 |
| Mechanical Engineering: Core Qualification: Compulsory |
| Naval Architecture: Core Qualification: Compulsory |

| Course L0264: Advanced Me | chanical Engineering Design II |
|---------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 |
| | • Elements of hubbles |
| | Exercise |
| | Calculation methods of the following machine elements: |
| | Linear rolling bearings |
| | • Axes & shafts |
| | Clutches & brakes |
| | • Belt & chain drives |
| | • Gear drives |
| | • Epicyclic gears |
| | Crank gears |
| | Sliding bearings |
| | Calculations of hydrostatic systems (fluidics) |
| Literature | Dubbel Teachadach für den Maaskinghen, Orste 17. H. Feldburgen 17. Hern Vielan, staate staate |
| | Dubbel, Taschenbuch f ür 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 L0265: Advanced Mechanical Engineering Design II | |
|---|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| CP | 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 |

| qyT | Lecture |
|-------------------|--|
| Hrs/wk | |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | |
| Language | |
| Cycle | |
| | 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 |
| | 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, aktu |
| | 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 |
| CP | 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 | Typ Hrs/wk CP |
| Advanced Mechanical Design Proje | |
| Module Responsible | Dr. Jens Schmidt |
| Admission Requirements | None |
| Recommended Previous | Mechanical Engineering: Design |
| Knowledge | Advanced Mechanical Engineering Design |
| | |
| | After taking part successfully, students have reached the following learning results |
| Professional Competence | |
| Knowledge | After passing the module, students are able to: |
| | express the procedure for systematically handling of |
| | • complex design tasks , |
| | describe working principles, their use and combination possibilities, |
| | explain guidelines for designing for function and manufacturing, |
| | explain advanced use-oriented knowledge of machine elements. |
| Skills | After passing the module, students are able to: |
| | analyze complex tasks and develop principle solutions using sketches, |
| | analyze complex tasks and develop principle solutions using sketches, convert principle solutions into a detailed design, |
| | use methods to design and solve engineering design tasks systematically and solution-oriented, |
| | create a technical documentation including all necessary technical drawings to understand the functions of the system, |
| | document calculations of selected machine elements clearly and in detail. |
| Deveral Competence | |
| Personal Competence | After passing the module, students are able to: |
| Social competence | Alter passing the module, students are able to. |
| | present and discuss solutions and technical drawings within groups, |
| | reflect the own results in the work groups of the course |
| Autonomy | After passing the module, students are able to: |
| | |
| | independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and select appropriate methods, |
| | to independently solve problems. |
| | |
| | Independent Study Time 124, Study Time in Lecture 56 |
| Credit points | 6 Compulsory Bonus Form Description |
| Course achievement | Yes None Attestation |
| Examination | Written exam |
| Examination duration and | 180 |
| scale | |
| Assignment for the | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste |
| Following Curricula | Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developme |
| | and Production: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste |
| | Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm |
| | and Production: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechani |
| | Engineering: Compulsory |
| | |

| Course L0266: Advanced Med | chanical Design Project |
|----------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| CP | 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 |
| Computer Engineering (L0321) | | Lecture | 3 | 4 |
| Computer Engineering (L0324) | | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Heiko Falk | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge in electrical engineering | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reach | ned the following learning results | | |
| Professional Competence | | | | |
| Knowledge | This module deals with the foundations of the fu programming down to gates. The module includes • Introduction | | ers the layers fron | the assembly-le |
| | Introduction Combinational logic: Gates, Boolean algebra Sequential logic: Flip-flops, automata, syste Technological foundations Computer arithmetic: Integer addition, subt Basics of computer architecture: Programm Memories: Memory hierarchies, SRAM, DRA Input/output: I/O from the perspective of the | matic hardware design raction, multiplication and division ing models, MIPS single-cycle architecture M, caches | , pipelining | |
| Skills | The students perceive computer systems from the composition of computer systems. The students construction of few and simple components. They a today's computing systems - from gates and circu After successful completion of the module, the s system and the software executed on it. In partici- on the hardware-centric abstraction layers from the the impact that these low abstraction levels have | an analyze, how highly specific and individ re able to distinguish between and to exp its up to complete processors. tudents are able to judge the interdeper ular, they shall understand the consequer ne assembly language down to gates. This | dual computers can blain the different indencies between inces that the exect s way, they will be | h be built based o abstraction layers a physical compu- ution of software l enabled to evalue |
| Demonstration of the second se | | | | |
| Personal Competence | Students are able to solve similar problems along | or in a group and to procent the results as | cordinaly | |
| Social Competence | Students are able to solve similar problems alone | or in a group and to present the results ac | cordingly. | |
| Autonomy | Students are able to acquire new knowledge from | specific literature and to associate this kn | owledge with othe | r classes. |
| Workload in Hours | Independent Study Time 124, Study Time in Lectu | re 56 | | |
| Credit points | | | | |
| Course achievement | Compulsory Bonus Form | Description | | |
| | Yes 10 % Excercises | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 minutes, contents of course and labs | | | |
| scale | | | | |
| Assignment for the | | | | |
| Following Curricula | | | | |
| | General Engineering Science (German program, 7 | | | |
| | General Engineering Science (German program | n, 7 semester): Specialisation Mechanic | cal Engineering, I | ocus Mechatroni |
| | Compulsory | 7 competer), Enocialization Machanical | Engineering For | ue Aircraft Sucto |
| | General Engineering Science (German program, Engineering: Compulsory | / semester): specialisation Mechanical | Engineering, Foc | us Aircrait Syste |
| | General Engineering Science (German program, 7 | semester): Specialisation Mechanical End | ineerina. Focus Th | eoretical Mechani |
| | Engineering: Compulsory | English and the second s | g, 10005 Th | |
| | | | | |
| | General Engineering Science (German program | n, 7 semester): Specialisation Mechan | ical Engineering, | Focus Materials |
| | | n, 7 semester): Specialisation Mechan | ical Engineering, | Focus Materials |
| | General Engineering Science (German program | | | |
| | General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory | 7 semester): Specialisation Mechanical En | gineering, Focus P | roduct Developm |
| | General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program, | 7 semester): Specialisation Mechanical En | gineering, Focus P | roduct Developme |
| | General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program, Compulsory | 7 semester): Specialisation Mechanical En 7 semester): Specialisation Mechanical | gineering, Focus P Engineering, Foc | roduct Developm us Energy Syster |
| | General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program | 7 semester): Specialisation Mechanical En 7 semester): Specialisation Mechanical | gineering, Focus P Engineering, Foc | roduct Developm us Energy Syster |
| | General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program, Compulsory | 7 semester): Specialisation Mechanical En 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanic semester): Specialisation Naval Architectu semester): Specialisation Biomedical Engi semester): Specialisation Bioprocess Engi semester): Specialisation Electrical Engine | gineering, Focus P Engineering, Foc al Engineering, Foc ure: Compulsory neering: Compulsory neering: Compulsory eering: Compulsory | roduct Developm us Energy Syster ocus Biomechani pry ry |
| | General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, 7 General Engineering Science (German program, 7 | 7 semester): Specialisation Mechanical En 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanic semester): Specialisation Naval Architectu semester): Specialisation Biomedical Engi semester): Specialisation Bioprocess Engi semester): Specialisation Electrical Engine semester): Specialisation Green Technolo | gineering, Focus P Engineering, Foc al Engineering, Foc ure: Compulsory neering: Compulsory neering: Compulsory eering: Compulsory | roduct Developm us Energy Syster ocus Biomechani yry ry |
| | General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, 7 General Engineering Science (German program, 7 | 7 semester): Specialisation Mechanical En 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanic semester): Specialisation Naval Architectu semester): Specialisation Biomedical Engi semester): Specialisation Bioprocess Engi semester): Specialisation Electrical Engine semester): Specialisation Green Technolo | gineering, Focus P Engineering, Foc al Engineering, Foc ure: Compulsory neering: Compulsory neering: Compulsory eering: Compulsory | roduct Developm us Energy Syster ocus Biomechani yry ry |
| | General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, 7 General Engineering Science (German program, 7 Compulsory Computer Science: Core Qualification: Compulsory | 7 semester): Specialisation Mechanical En 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanic semester): Specialisation Naval Architectu semester): Specialisation Biomedical Engi semester): Specialisation Bioprocess Engi semester): Specialisation Electrical Engine semester): Specialisation Green Technolo | gineering, Focus P Engineering, Foc al Engineering, Foc ure: Compulsory neering: Compulsory neering: Compulsory eering: Compulsory | roduct Developm us Energy Syster ocus Biomechani yry ry |
| | General Engineering Science (German program Engineering Sciences: Compulsory General Engineering Science (German program, 7 and Production: Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, Compulsory General Engineering Science (German program, 7 General Engineering Science (German program, 7 Compulsory Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulse | 7 semester): Specialisation Mechanical En 7 semester): Specialisation Mechanical n, 7 semester): Specialisation Mechanic semester): Specialisation Naval Architectu semester): Specialisation Biomedical Engi semester): Specialisation Bioprocess Engi semester): Specialisation Electrical Engine semester): Specialisation Green Technolo , sory sory semester): Specialisation Civil Engineering | gineering, Focus P Engineering, Foc al Engineering, Foc ure: Compulsory neering: Compulsory neering: Compulsory gies, Focus Renew | roduct Developm us Energy Syster ocus Biomechan my ry ry able Energy: Elect |

| 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 |
| 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 | |
| CP | 4 | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE/EN | |
| 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 Eng | ourse L0324: Computer Engineering | |
|----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE/EN | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|-----------------------------------|--|---|--------------------|----------------------|
| Title | | Тур | Hrs/wk | СР |
| Computational Fluid Dynamics I (L | | Lecture | 2 | 3 |
| Computational Fluid Dynamics I (L | | Recitation Section (large) | 2 | 3 |
| Module Responsible | | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mathematical Methods for Engineers | | | |
| Knowledge | Fundamentals of Differential/integral calculu | is and series expansions | | |
| | | | | |
| Educational Objectives | After taking part successfully, students have reach | ed the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are able to list the basic numerics of | partial differential equations. | | |
| | | | | |
| | | | | |
| SKIIIS | The students are able develop appropriate numeric | | overning partial d | ifferential equation |
| | They can code computational algorithms in a struct | tured way. | | |
| | | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | The students can arrive at work results in groups a | nd document them. | | |
| | | | | |
| | | | | |
| Autonomy | The students can independently analyse approache | es to solving specific problems. | | |
| | | | | |
| | | | | |
| | | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lectur | re 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 2h | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 | semester): Specialisation Mechanical Engir | neering, Focus Th | eoretical Mechanio |
| Following Curricula | Engineering: Elective Compulsory | | | |
| | General Engineering Science (German program, | 7 semester): Specialisation Mechanical | Engineering, Foc | us Aircraft Syster |
| | Engineering: Elective Compulsory | | | |
| | General Engineering Science (German program, | 7 semester): Specialisation Mechanical | Engineering, Foc | us Energy System |
| | Elective Compulsory | | | |
| | General Engineering Science (German program, 7 s | • | | ing Compulsor |
| | General Engineering Science (German program, 7 s Energy Systems: Technical Complementary Course | | omentai Engineei | ing: compulsory |
| | General Engineering Science (English program, 7 s | | mental Engineeri | ing: Compulsory |
| | General Engineering Science (English program, 7 s | | | |
| | Elective Compulsory | | J | |
| | General Engineering Science (English program, 7 s | emester): Specialisation Naval Architecture | e: Compulsory | |
| | General Engineering Science (English program, | | 1 | us Aircraft Syster |
| | Engineering: Elective Compulsory | • | | |
| | Mechanical Engineering: Specialisation Energy Syst | tems: Elective Compulsory | | |
| | Mechanical Engineering: Specialisation Aircraft Sys | tems Engineering: Elective Compulsory | | |
| | | | | |
| | Naval Architecture: Core Qualification: Compulsory | | | |

| Course L0235: Computationa | al Fluid Dynamics I |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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. Partial differential equations Foundations of finite numerical approximations Computation of potential flows Introduction of finite-differences Approximation of convective, diffusive and transient transport processes Formulation of boundary conditions and initial conditions Assembly and solution of algebraic equation systems Facets of weighted -residual approaches Finite volume methods Basics of grid generation |
| Literature | Ferziger and Peric: Computational Methods for Fluid Dynamics, Springer |

| Course L0419: Computationa | urse 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 | Typ Hrs/wk CP |
| Numerical Mathematics I (L0417) | Lecture 2 3 |
| Numerical Mathematics I (L0418) | Recitation Section (small) 2 3 |
| Module Responsible | Prof. Sabine Le Borne |
| Admission Requirements | None |
| Recommended Previous | |
| Knowledge | Mathematik I + II for Engineering Students (german or english) or Analysis & Linear Algebra I + II for Technomathematic here MATLAP (Dither leaveledge) |
| | basic MATLAB/Python knowledge |
| Educational Objectives | After taking part successfully, students have reached the following learning results |
| Professional Competence | |
| Knowledge | Students are able to |
| | name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root fil |
| | 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 computational and storage complexitx |
| | |
| | |
| Skills | Students are able to |
| D.M.D | |
| | implement, apply and compare numerical methods using MATLAB/Python, |
| | 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 | Students are able to |
| , | |
| | work together in heterogeneously composed teams (i.e., teams from different study programs and background knowle |
| | explain theoretical foundations and support each other with practical aspects regarding the implementation of algorithm |
| 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 |
| Course achievement | None |
| Examination | Written exam |
| Examination duration and | 90 minutes |
| scale | |
| Assignment for the | General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materia |
| | 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 Biomecha |
| | Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mecha |
| | Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Sys |
| | Engineering: Elective Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: Ele |
| | Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syst |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory |
| | Computer Science: Specialisation Computational Mathematics: Elective Compulsory |
| | Computer Science: Specialisation II. Mathematics and Engineering Science: Elective Compulsory |
| | Data Science: Core Qualification: Compulsory |
| | Electrical Engineering: Core Qualification: Elective Compulsory |
| | Engineering Science: Core Qualification: Compulsory |
| | Engineering Science: Core Qualification: Compulsory |
| | General Engineering Science (English program, 7 semester): Core Qualification: Compulsory |
| | |
| | General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecha |
| | |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecha |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecha Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecha Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engine |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecha Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engine Sciences: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecha Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engine Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomecha Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engine Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical Engineering: Compulsory |

Computational Science and Engineering: Core Qualification: Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Mechanical Engineering: Specialisation Mechatronics: Elective Compulsory

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

Process Engineering: Specialisation Process Engineering: Elective Compulsory

| Course L0417: Numerical Ma | thematics I | | |
|----------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| CP | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Sabine Le Borne | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss quadrature, adaptive quadrature | | |
| Literature | Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer | | |

| Course L0418: Numerical Ma | irse L0418: Numerical Mathematics I | |
|----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| CP | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Sabine Le Borne, Dr. Jens-Peter Zemke | |
| Language | EN | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|-----------------------------------|---|--|----------------------|----------------------|
| Title | | Тур | Hrs/wk | СР |
| Simulation and Design of Mechatro | nic Systems (L1822) | Lecture | 2 | 2 |
| Simulation and Design of Mechatro | nic Systems (L1823) | Recitation Section (large) | 1 | 2 |
| Simulation and Design of Mechatro | nic Systems (L1824) | Practical Course | 1 | 2 |
| Module Responsible | NN | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Fundatmentals of mechanics, control theory an | d electrical engineering | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have re- | ached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to describe methods and calc | ulations for design, modeling, simulation ar | nd optimization of n | mechatronic systen |
| Skills | Students are able to apply modern algorithms f | or modeling of mechatronic systems. They | can identify simula | ate and design sim |
| JKIIIS | systems and implement those in laboratory con | | can lacitary, simula | ace und design silli |
| | systems and implement close in laboratory con | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to work goal-oriented in smal | I mixed groups and present results to targe | t groups. | |
| Autonomy | Students are able to recognize and improve knowledge deficits independently. | | | |
| | With instructor assistance, students are able to evaluate their own knowledge level and define a further course of study. | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program | , 7 semester): Specialisation Mechanical Er | ngineering, Focus M | lechatronics: Elect |
| Following Curricula | Compulsory | | | |
| | General Engineering Science (German progra | m, 7 semester): Specialisation Mechanica | al Engineering, Fo | cus Aircraft Syste |
| | Engineering: Elective Compulsory | | | |
| | Digital Mechanical Engineering: Core Qualificati | on: Compulsory | | |
| | General Engineering Science (English program, | 7 semester): Specialisation Mechanical En | gineering, Focus Tl | heoretical Mechani |
| | Engineering: Elective Compulsory | | | |
| | General Engineering Science (English progra | m, 7 semester): Specialisation Mechanica | al Engineering, Foo | cus Aircraft Syste |
| | Engineering: Elective Compulsory | | | |
| | General Engineering Science (English program | , 7 semester): Specialisation Mechanical Er | igineering, Focus M | lechatronics: Elect |
| | Compulsory | | | |
| | Mechanical Engineering: Specialisation Theoret | ical Mechanical Engineering: Elective Comp | ulsory | |
| | Mechanical Engineering: Specialisation Aircraft | | - | |
| | Mechanical Engineering: Specialisation Aircraft | | | |
| | Mechanical Engineering: Specialisation Mechatr | | | |
| | Mechanical Engineering: Specialisation Mechatr | | | |
| | Mechatronics: Core Qualification: Compulsory | · · · · · · · · · · · · · · · · · · · | | |
| | Mechatronics: Core Qualification: Compulsory | | | |

| Course L1822: Simulation and Design of Mechatronic Systems | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | NN | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Mechatronic Design | |
| | Modeling | |
| | Iodel Identifikation | |
| | umerical Methods in simulation | |
| | Applications and examples in Matlab $^{\circledast}$ and Simulink $^{\circledast}$ | |
| Literature | Skript zur Veranstaltung | |
| | Weitere Literatur in der Veranstaltung | |

| ourse L1823: Simulation and Design of Mechatronic Systems | | | |
|---|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | NN | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |
| | | | |
| Course L1824: Simulation an | d Design of Mechatronic Systems | | |
| Тур | Practical Course | | |
| Hrs/wk | 1 | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| | | | |

| Lecturer | NN |
|------------|-------------------------|
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Module M0599: Integ | rated Product I | Development and | d Lightweigh | t Design | | |
|------------------------------------|-------------------------------------|---------------------------------------|---------------------|------------------------------------|------------------|---------------------|
| Courses | | | | | | |
| Title | | | | Тур | Hrs/wk | СР |
| CAE-Team Project (L0271) | | | | Project-/problem-based Learning | 2 | 2 |
| Development of Lightweight Design | n Products (L0270) | | | Lecture | 2 | 2 |
| Integrated Product Development I (| (L0269) | | | Lecture | 2 | 2 |
| Module Responsible | Prof. Dieter Krause | | | | | |
| Admission Requirements | None | | | | | |
| | Advanced Knowledge | about engineering desi | gn: | | | |
| Knowledge | Fundamentals of Mec | hanical Engineering Des | ign | | | |
| | Mechanical Engineeri | ng: Design | | | | |
| | Advanced Mechanical | | | | | |
| Educational Objectives | After taking part succ | essfully, students have | reached the followi | ng learning results | | |
| Professional Competence | | | | | | |
| Knowledge | After completing the | module, students are ca | pable of: | | | |
| | explaining the | functional principle of 3 | D-CAD-Systems, PD | M- and FEM-Systems | | |
| | | | | the product development proces | S | |
| | | | | | | |
| Skills | | | | | | |
| | After completing the | module, students are ab | le to: | | | |
| | | | | | | |
| | | | | | | |
| | evaluate differ | ent CAD- and PDM-Sys | tems with regards | to the desired requirements su | ich as classific | ation schemes and |
| | product structu | ıring | | | | |
| | design an exer | nplary product using CA | D-,PDM- and/or FEN | 1-Systems with shared workload | | |
| | | | | | | |
| | | | | | | |
| Personal Competence | | | | | | |
| Social Competence | After completing the | module, students are ab | le to: | | | |
| | To develop a p | roiect plan and allocate | work appropriate w | ork packages in the framework | of aroup discus | ssions |
| | | results as a team for in | | | <u>5</u> p | |
| | | | | | | |
| Autonomy | Students are capable | of: | | | | |
| | independently | adapt to a CAE-Tool and | l complete a given | practical task with it | | |
| | | · · · · · · · · · · · · · · · · · · · | | | | |
| Workload in Hours | Independent Study Ti | me 96, Study Time in Le | ecture 84 | | | |
| Credit points | | | | | | |
| Course achievement | | Form | Description | pickt inkl. Vortrag und Ausarboiti | ing | |
| | Yes 20 % | Subject theoretical practical work | andCAE-reampro | ojekt inkl. Vortrag und Ausarbeitu | ing | |
| Examination | Written exam | practical work | | | | |
| Examination duration and | 4 | | | | | |
| scale | | | | | | |
| Assignment for the | | Science (German proc | Iram. 7 semester) | : Specialisation Mechanical End | ineerina. Focu | is Aircraft Systems |
| Following Curricula | 5 5 | | ,,, | | | |
| 5 | | | am, 7 semester): S | pecialisation Mechanical Engine | ering, Focus Pr | oduct Development |
| | and Production: Comp | oulsory | | | | |
| | Engineering Science: | Specialisation Mechanic | al Engineering: Ele | ctive Compulsory | | |
| | General Engineering | Science (English prog | ram, 7 semester): | Specialisation Mechanical Eng | ineering, Focu | s Aircraft Systems |
| | Engineering: Compuls | sory | | | | |
| | General Engineering | Science (English progra | m, 7 semester): S | pecialisation Mechanical Enginee | ering, Focus Pr | oduct Development |
| | and Production: Comp | oulsory | | | | |
| | | | | ecialisation Mechanical Engineeri | ng: Elective Co | mpulsory |
| | - | | | d Production: Compulsory | | |
| | - | ng: Specialisation Aircra | | | | |
| | Product Development | , Materials and Producti | on: Technical Comp | plementary Course Core Studies: | Elective Comp | ulsory |

| Course L0271: CAE-Team Pro | ject |
|----------------------------|--|
| 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: Integrated Pr | oduct Development l | | |
|-----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | | | |
| CP | 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 M0865: Funda | mentals of Production and | Quality Management | | |
|------------------------------------|---|---|------------------------|---------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Production Process Organization (L | 925) | Lecture | 2 | 3 |
| Quality Management (L0926) | | Lecture | 2 | 3 |
| Module Responsible | Prof. Hermann Lödding | | | |
| Admission Requirements | None | | | |
| Recommended Previous | None | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students | have reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to explain the content | ts of the lecture of the module. | | |
| Skills | Students are able to apply the methods and models in the module to industrial problems. | | | |
| Personal Competence | | | | |
| Social Competence | - | | | |
| Autonomy | - | | | |
| Workload in Hours | Independent Study Time 124, Study Tin | ne in Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 180 Minuten | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German | program, 7 semester): Specialisation Mechan | nical Engineering, Foc | us Aircraft Systems |
| Following Curricula | Engineering: Compulsory | | | |
| | General Engineering Science (German | program, 7 semester): Specialisation Mechanica | l Engineering, Focus P | Product Development |
| | and Production: Compulsory | | | |
| | Engineering Science: Core Qualification: | | | |
| | | rogram, 7 semester): Specialisation Mechanical E | | ompulsory |
| | | ogram, 7 semester): Core Qualification: Comput | - | |
| | | oduction Management and Processes: Compulso | ry | |
| | Logistics and Mobility: Specialisation En | | | |
| | Mechanical Engineering: Core Qualificat | | | |
| | Engineering and Management - Major in | Logistics and Mobility: Specialisation Production | n Management and Pro | cesses: Compulsory |

| Course L0925: Production Pr | ocess Organization | | |
|-----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| CP | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Hermann Lödding | | |
| Language | | | |
| Cycle | | | |
| Content | (A) Introduction | | |
| | (B) Product planning | | |
| | (C) Process planning | | |
| | Procurement | | |
| | Manufacturing | | |
| | (F) Production planning and control (PPC) | | |
| | (G) Distribution | | |
| | (H) Cooperation | | |
| Literature | Wiendahl, HP.: Betriebsorganisation für Ingenieure | | |
| | Vorlesungsskript | | |

| Course L0926: Quality Manag | jement |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 |

| Module M0767: Aeror | autical Systems | | | | |
|---|---|---|--------------------------|---|--|
| Module M0707: Aeror | lautical Systems | | | | |
| Courses | | | | | |
| Title | | Тур | Hrs/wl | k CP | |
| Fundamentals of Aircraft Systems (| L0741) | Lecture | 2 | 2 | |
| Fundamentals of Aircraft Systems (| L0742) | Recitation Section | n (small) 1 | 1 | |
| Air Transportation Systems (L0591 | 1 | Lecture | 2 | 2 | |
| Air Transportation Systems (L0816 | | Recitation Section | n (large) 1 | 1 | |
| Module Responsible | Prof. Frank Thielecke | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Basics of mathematics, mechanics and the | ermodynamics | | | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students ha | ve reached the following learning result | S | | |
| Professional Competence | | | | | |
| Knowledge | Students get a basic understanding of th | e structure and design of an aircraft, | as well as an overview | of the systems inside a | |
| | aircraft. In addition, a basic knowledge of | the relationchips, the key parameters, | roles and ways of workir | ng in different subsyster | |
| | 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 thei | | | | |
| | technical system implementation. In additi | | | | |
| | the air transportation system in the context of the overall system. | | | | |
| Personal Competence | | · · · · · · · · · · · · · · · · · · · | | | |
| | Students are made aware of interdisciplina | ary communication in groups. | | | |
| | Students are able to independently anal | | eir technical implement | tation as well as to thi | |
| ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | system oriented. | | | | |
| Workload in Hours | Independent Study Time 96, Study Time ir | Lecture 84 | | | |
| Credit points | | | | | |
| Course achievement | | | | | |
| Examination | Written exam | | | | |
| Examination duration and | 150 min | | | | |
| scale | | | | | |
| Assignment for the | General Engineering Science (German p | rogram, 7 semester); Specialisation | Mechanical Engineering | . Focus Aircraft Syster | |
| - | Engineering: Compulsory | | | ,,,., | |
| 3 | General Engineering Science (English p | rogram, 7 semester); Specialisation I | Aechanical Engineering | . Focus Aircraft Syster | |
| | Engineering: Compulsory | | | , | |
| | Logistics and Mobility: Specialisation Logis | tics and Mobility: Elective Compulsory | | | |
| | Logistics and Mobility: Specialisation Traffi | | ulsory | | |
| | Mechanical Engineering: Specialisation Ham | | | | |
| | Engineering and Management - Major in Lo | | | s: Elective Compulsory | |
| | | pristics and Mobility, specialisation fra | ne rialilling and system | is. Liective compulsory | |

| Course L0741: Fundamentals of Aircraft Systems | |
|--|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 Transporta | ation Systems |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 |
| Literature | V. Gollnick, D. Schmitt: "Air Transport System", Springer-Verlag, ISBN 978-3-7091-1879-5 H. Mensen: "Handbuch der Luftfahrt", Springer-Verlag, 2003 J.P. Clark: "Buying the Big Jets", ISBN 9781317170341, Taylor & Francis, 2017 Mike Hirst: The Air Transport System, AIAA, 2008 D.P. Raymer: "Aircraft Design - A Conceptual Approach", AIAA Education Series, 2006, ISBN 1-56347-281-3 N. Ashford: "Airport Operations", McGraw-Hill, 1997, ISBN 0-07-003077-4 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 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Volker Gollnick |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

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: Adva | nced Mechanical Engineering Desig | jn | | |
|---------------------------------|--|---|--------------------|-----------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Advanced Mechanical Engineering | Design II (L0264) | Lecture | 2 | 2 |
| Advanced Mechanical Engineering | Design II (L0265) | Recitation Section (large) | 2 | 1 |
| Advanced Mechanical Engineering | Design I (L0262) | Lecture | 2 | 2 |
| Advanced Mechanical Engineering | Design I (L0263) | Recitation Section (large) | 2 | 1 |
| Module Responsible | Prof. Dieter Krause | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | Fundamentals of Mechanical Engineering De Mechanics | esign | | |
| | Fundamentals of Materials Science | | | |
| | Production Engineering | | | |
| | • Houdedon Engineering | | | |
| Educational Objectives | After taking part successfully, students have reach | ed the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After passing the module, students are able to: | | | |
| | | | | |
| | explain complex working principles and function | | | |
| | explain requirements, selection criteria, app indicate the background of dimensioning cal | | of complex machi | ne elements, |
| | Indicate the background of dimensioning call | iculations. | | |
| Skills | After passing the module, students are able to: | | | |
| | - eccentrich dimensioning coloulations of cou | and machine alements | | |
| | accomplish dimensioning calculations of cov | | huing altilla) | |
| | transfer knowledge learned in the module to recognize the content of technical drawings | | iving skills), | |
| | recognize the content of technical drawings evaluate complex designs, technically. | and schematic sketches, | | |
| | • evaluate complex designs, technically. | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| | Students are able to discuss technical inform | nation in the lecture supported by activation | ng methods. | |
| Autonomy | | | | |
| | Students are able to independently deepen | | | |
| | Students are able to acquire additional know | owledge and to recapitulate poorly under | stood content e.g | . by using the vide |
| | recordings of the lectures. | | | |
| Workload in Hours | Independent Study Time 68, Study Time in Lecture 112 | | | |
| Credit points | | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 | semester): Specialisation Mechanical Engi | neering: Compuls | ory |
| | General Engineering Science (German program | | | |
| | Compulsory | | | |
| | General Engineering Science (German program, | 7 semester): Specialisation Mechanical | Engineering, Foc | us Energy System |
| | Compulsory | | | |
| | General Engineering Science (German program, | 7 semester): Specialisation Mechanical | Engineering, For | us Aircraft Systen |
| | Engineering: Compulsory | | | |
| | General Engineering Science (German program | n, 7 semester): Specialisation Mechani | cal Engineering, | Focus Materials |
| | Engineering Sciences: Compulsory | | | |
| | General Engineering Science (German program | , 7 semester): Specialisation Mechanic | al Engineering, | Focus Mechatronic |
| | Compulsory | | | |
| | General Engineering Science (German program, 7 | semester): Specialisation Mechanical Eng | Jineering, Focus P | Product Developme |
| | and Production: Compulsory | | | |
| | General Engineering Science (German program, 7 | semester): Specialisation Mechanical Engi | neering, Focus Th | neoretical Mechanic |
| | Engineering: Compulsory | | | |
| | Energy Systems: Technical Complementary Course | | | |
| | Engineering Science: Specialisation Mechanical Eng | | | |
| | General Engineering Science (English program, 7 s | | | |
| | General Engineering Science (English program, | / semester): Specialisation Mechanica | ॥ Engineering, F | ocus Biomechanic |
| | Compulsory | | Fasiana i F | |
| | General Engineering Science (English program, | / semester): specialisation Mechanical | Engineering, Foc | us Energy System |
| | Compulsory | 7 semester): Specialisation Mechanical | Engineering For | us Aircraft Suctor |
| | General Engineering Science (English program, Engineering: Compulsory | , semestery, specialisation Mechanical | Ligineening, FOC | us Anciait Systen |
| | | omostor), Specialization Machanical Engin | eering Feering Me | |
| | | | | terials in Engineerin |
| | General Engineering Science (English program, 7 s | emester). Specialisation Mechanical Engli | ieening, Focus Ma | terials in Engineerir |

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 Mechanical Engineering: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory

| | chanical Engineering Design II |
|-------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 |
| | • Elements of hubbles |
| | Exercise |
| | Calculation methods of the following machine elements: |
| | Linear rolling bearings |
| | Axes & shafts |
| | Clutches & brakes |
| | Belt & chain 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. |
| | Konstruktionslehre, Falli, G., Beliz, 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 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 |

| | Lastura |
|------------|--|
| Тур | |
| Hrs/wk | |
| СР | |
| | Independent Study Time 32, Study Time in Lecture 28 |
| | Prof. 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 |
| | 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, aktue |
| | Auflage. |
| | Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. |
| | Sowie weitere Bächer zu speziellen Themen |

| Course L0263: Advanced Mechanical Engineering Design I | |
|--|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| CP | 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 |
| Fundamentals of Mechanical Propert | ties of Materials (L1090) | Lecture | 2 | 3 |
| Welding Technology (L1123) | Lecture 3 3 | | | 3 |
| Module Responsible | Prof. Claus Emmelmann | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Fundamentals of Materials Science | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students hav | ve reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students get to know the principles the | at are responsible for the mechanical behav | iour of metals. They acq | uire basic knowleg |
| | in modelling of the materials behaviour. Fu | urthermore, the students learn about the be | haviour of metals under | r static and dynan |
| | loads. The students get to know the most | important welding technologies and the co | orresponding systems. T | They learn about t |
| | influence of welding on the materials and c | lesign. | | |
| Chille | The students know the masherical prope | which of matche and the underlying princip | les They are able to m | ana tha influenc |
| | | erties of metals and the underlying princip | les. They are able to h | ame the innuenc |
| | factors on the welding behaviour of steel m | laterials. | | |
| | The students are able to select between al | loys according to the desired mechaincal pr | operties and welability. | They can distingu |
| | between different welding techniques and select the suitable technique and system components for a defined application. | | application. They | |
| | able to dimension weld joints within design tasks. | | | |
| Personal Competence | | | | |
| Social Competence | none | | | |
| Autonomy | none | | | |
| Workload in Hours | Independent Study Time 110, Study Time i | n Lecture 70 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| | General Engineering Science (German | program, 7 semester): Specialisation Me | echanical Engineering, | Focus Materials |
| Assignment for the | Engineering Sciences: Compulsory | | 5 5. | |
| 5 | | | Engineering Focus Mat | orials in Engineer |
| Following Curricula | General Engineering Science (English prog | ram, 7 semester): Specialisation Mechanica | i Liigineenng, Locus Mai | |
| Following Curricula | General Engineering Science (English prog Sciences: Compulsory | ram, 7 semester): Specialisation Mechanica | r Engineering, rocus Mai | Lendis in Engineer |
| Following Curricula | 5 5 7 5 | ram, 7 semester): Specialisation Mechanica | Lingineering, rocus Ma | |
| Following Curricula | 5 5 7 5 | ram, 7 semester): Specialisation Mechanica | | |

| Тур | Lecture | |
|-------------------|---|--|
| Hrs/wk | 2 | |
| CP | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Norbert Huber | |
| Language | DE | |
| Cycle | Se | |
| Content | 1. Introduction and overview | |
| | 2. Bonding and crystallography, stress, strain, linear elasticity | |
| | 3. Plasticity of metallic materials | |
| | 4. Dislocations: Structure, stress, strain, strain energy | |
| | 5. Dislocations: Motion and forces | |
| | 6. Partial dislocations, dislocation interactions, jogs and kinks | |
| | 7. Strengthening mechanisms | |
| | 8. Introduction to modelling of materials behaviour, classification of | |
| | phenomena | |
| | 9. Linear and nonlinear elasticity | |
| | 10. Plasticity, tensile loading, cyclic loading | |
| | 11. Viscoelasticity, effects of loading history, creep, relaxation | |
| | 12. Viscoplasticity, overstress, rate sensitivity of metallic materials | |
| | 13. 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 Tech | nology |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 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 |
| Content | - 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 |
| | - 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 |
| | |
| Literature | 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. |
| | 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. |
| | |

| Courses | | | | |
|---------------------------------|---|--|---|---|
| Title | | Тур | Hrs/wk | СР |
| Numerical Mathematics I (L0417) | | Lecture | 2 | 3 |
| Numerical Mathematics I (L0418) | | Recitation Section (small) | 2 | 3 |
| Module Responsible | Prof. Sabine Le Borne | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mathematik I + II for Engineering Students (g) | erman or english) or Analysis & Linear Alg | rebra I + II for Te | chnomathematic |
| Knowledge | basic MATLAB/Python knowledge | | | ennomathematik |
| | | | | |
| - | After taking part successfully, students have reache | d the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to | | | |
| | name numerical methods for interpolation, in | ntegration, least squares problems, eigenv | alue problems, r | ionlinear root fin |
| | problems and to explain their core ideas, | | | |
| | repeat convergence statements for the nume | erical methods, | | |
| | explain aspects for the practical execution of | numerical methods with respect to compo | utational and stor | age complexitx. |
| | | | | |
| | | | | |
| Skills | Students are able to | | | |
| | implement, apply and compare numerical me | ethods using MATLAB/Python | | |
| | justify the convergence behaviour of numeric | | nd solution algori | thm |
| | select and execute a suitable solution approx | | na seración argen | , |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to | | | |
| | work together in heterogeneously composed | teams (i.e., teams from different study pr | ograms and bac | around knowled |
| | explain theoretical foundations and support e | | | |
| | | | | |
| 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 nece | | · · · · , · | |
| | | | | |
| Workload in Hours | | 2 56 | | |
| Credit points | | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 minutes | | | |
| scale | | | | |
| | General Engineering Science (German program, 7 s | | | |
| Following Curricula | General Engineering Science (German program | , 7 semester): Specialisation Mechanic | al Engineering, | Focus Material |
| | Engineering Sciences: Compulsory | | | |
| | General Engineering Science (German program, 7 s | | | |
| | General Engineering Science (German program, Compulsory | / semester). Specialisation Mechanica | i Engineering, r | ocus biomecna |
| | General Engineering Science (German program, 7 s | emester): Specialisation Mechanical Engir | eering Focus Th | eoretical Mecha |
| | Engineering: Compulsory | Enclose , openandation mechanical Engli | | Longeneration Meerid |
| | General Engineering Science (German program, | 7 semester): Specialisation Mechanical | Engineerina. Foc | us Aircraft Svst |
| | Engineering: Elective Compulsory | , permanent i containeur | J | |
| | General Engineering Science (German program, 7 s | semester): Specialisation Mechanical Engli | neering, Focus M | echatronics: Elec |
| | | | - | |
| | Compulsory | | | |
| | Compulsory General Engineering Science (German program, | | Engineering, Foc | |
| | | | Engineering, Foc | |
| | General Engineering Science (German program, | 7 semester): Specialisation Mechanical I | | |
| | General Engineering Science (German program, Elective Compulsory | 7 semester): Specialisation Mechanical i Bioprocess Engineering: Elective Compulso | | |
| | General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory | ory | |
| | General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory | ory | |
| | General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General E Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso | ory | |
| | General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General E Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory | ory | |
| | General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory Y | ory | |
| | General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory y y meester): Core Qualification: Compulsory | nry pry | |
| | General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science | ory ory : Compulsory | us Energy Syste |
| | General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science | ory ory : Compulsory | us Energy Syste |
| | General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, Compulsory | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory ad Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical | ory ory : Compulsory Engineering, F | us Energy Syste ocus Biomecha |
| | General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory ad Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical | ory ory : Compulsory Engineering, F | us Energy Syste ocus Biomecha |
| | General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se Sciences: Compulsory | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine | ory ory : Compulsory Engineering, F eering, Focus Mat | us Energy Syste ocus Biomecha erials in Enginee |
| | General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine | ory ory : Compulsory Engineering, F eering, Focus Mat | us Energy Syste ocus Biomecha erials in Enginee |
| | General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se Sciences: Compulsory | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical Engine emester): Specialisation Mechanical Engine | ering, Focus Th | us Energy Syste ocus Biomecha erials in Enginee eoretical Mecha |
| | General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General B Computer Science: Specialisation Computational Ma Computer Science: Specialisation II. Mathematics an Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective C Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se Sciences: Compulsory General Engineering Science (English program, 7 se | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor compulsory y mester): Core Qualification: Compulsory mester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine emester): Specialisation Mechanical Engine | ering: Compulsory | us Energy Syste ocus Biomecha erials in Enginee eoretical Mecha Y |

Computational Science and Engineering: Core Qualification: Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Mechanical Engineering: Specialisation Mechatronics: Elective Compulsory

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

Process Engineering: Specialisation Process Engineering: Elective Compulsory

| Course L0417: Numerical Ma | thematics I | |
|----------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | | |
| CP | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Sabine Le Borne | |
| Language | EN | |
| Cycle | WiSe | |
| Content | Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss quadrature, adaptive quadrature | |
| Literature | Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer | |

| Course L0418: Numerical Ma | Irse L0418: Numerical Mathematics I | | | |
|----------------------------|---|--|--|--|
| Тур | Recitation Section (small) | | | |
| Hrs/wk | 2 | | | |
| CP | 3 | | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | | |
| Lecturer | Prof. Sabine Le Borne, Dr. Jens-Peter Zemke | | | |
| Language | EN | | | |
| Cycle | WiSe | | | |
| Content | See interlocking course | | | |
| Literature | See interlocking course | | | |

| Courses | | | | | | |
|-----------------------------------|--|---|------------------------|----------------------|--|--|
| ïtle | | Тур | Hrs/wk | СР | | |
| Companion Lecture for Materials S | cience Laboratory (L1088) | Lecture | 2 | 2 | | |
| Naterial Science Laboratory (L123 | 5) | Practical Course | 4 | 4 | | |
| Module Responsible | Prof. Kaline Pagnan Furlan | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | none | | | | | |
| Knowledge | | | | | | |
| Educational Objectives | After taking part successfully, students have | e reached the following learning results | | | | |
| Professional Competence | | | | | | |
| Knowledge | Students are able to give a summary of | the technical details of experiments in the | area of materials sc | iences and illust | | |
| | respective relationships. They are capable | of describing and communicating relevant p | problems and questio | ns using appropr | | |
| | technical language. They can explain the ty | pical process of solving practical problems ar | nd present related res | ults. | | |
| CL:!!!- | The students can be after the information of | | | | | |
| SKIIIS | The students can transfer their fundament | | | | | |
| | identity and overcome typical problems dur | ing the realization of experiments in the cont | ext of material scienc | es. | | |
| Personal Competence | | | | | | |
| Social Competence | Students are able to cooperate in small groups in order to conduct experiments in the context of materials sciences. They are at | | | | | |
| | to effectively present and explain their resu | Its alone or in groups in front of a qualified au | udience. | | | |
| | | | | | | |
| Autonomy | Students are capable of solving problems in | | | y are able to fill g | | |
| | | he literature and other sources provided by the | le supervisor. | | | |
| | Independent Study Time 96, Study Time in | Lecture 84 | | | | |
| Credit points | | | | | | |
| Course achievement | | | | | | |
| | Subject theoretical and practical work | | | | | |
| Examination duration and | Test reports on the respective tests and onl | ine learning modules with integrated success | control | | | |
| scale | | | | | | |
| Assignment for the | General Engineering Science (German p | rogram, 7 semester): Specialisation Mecl | hanical Engineering, | Focus Materials | | |
| Following Curricula | Engineering Sciences: Compulsory | | | | | |
| | General Engineering Science (German prog | ram, 7 semester): Specialisation Mechanical | Engineering, Focus F | Product Developn | | |
| | and Production: Elective Compulsory | | | | | |
| | General Engineering Science (English progra | am, 7 semester): Specialisation Mechanical E | ngineering, Focus Ma | terials in Enginee | | |
| | Sciences: Compulsory | | | | | |
| | Mechanical Engineering: Specialisation Prod | uct Development and Production: Compulsor | у | | | |
| | Mechanical Engineering: Specialisation Mate | erials in Engineering Sciences: Compulsory | | | | |
| | Product Development, Materials and Product | tion: Technical Complementary Course Core | Studies: Elective Com | pulsory | | |

| Тур | Lecture | | | | |
|-------------------|---|--|--|--|--|
| Hrs/wk | 2 | | | | |
| СР | 2 | | | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | | | |
| Lecturer | of. Kaline Pagnan Furlan | | | | |
| Language | DE | | | | |
| Cycle | WiSe | | | | |
| Content | Physico-chemical backgrounds and fundamental experimental principles with regard to the following experiments, the topics to be | | | | |
| | ddressed 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) | | | | |
| | B. 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 Scier | 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. Kaline Pagnan Furlan, Prof. Stefan Fritz Müller, Prof. Patrick Huber, Prof. Bodo Fiedler, Prof. Gerold Schneider, Prof. Jörg | | | |
| | Weißmüller | | | |
| Language | DE | | | |
| Cycle | WiSe | | | |
| Content | | | | |
| Literature | Vorlesungsunterlagen Grundlagen der Werkstoffwissenschaft I & II | | | |

| Courses | | | | | | |
|------------------------------|--|--|--|--|--|--|
| Title | | Тур | Hrs/wk | СР | | |
| Computer Engineering (L0321) | | Lecture | 3 | 4 | | |
| Computer Engineering (L0324) | | Recitation Section (small) | 1 | 2 | | |
| Module Responsible | Prof. Heiko Falk | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Basic knowledge in electrical engineering | | | | | |
| Knowledge | | | | | | |
| Educational Objectives | After taking part successfully, 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 layers from the assembly-leprogramming 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 Institution of the collecture of the COLL arisingle of pageing data paint to paint to page the paint to page the page | | | | | |
| Skills | 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 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 evaluat the impact that these low abstraction levels have on an entire system's performance and to propose feasible options. | | | | | |
| Personal Competence | | | | | | |
| | Students are able to solve similar problems alor | e or in a group and to present the results ac | cordinaly | | | |
| Social Competence | Students are able to solve similar problems alon | e of in a group and to present the results ac | .corunigiy. | | | |
| Autonomy | Students are able to acquire new knowledge fro | m specific literature and to associate this kn | owledge with othe | r classes. | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lec | ture 56 | | | | |
| Credit points | | | | | | |
| Course achievement | | Description | | | | |
| | Yes 10 % Excercises | | | | | |
| Examination | Written exam | | | | | |
| Examination duration and | 90 minutes, contents of course and labs | | | | | |
| scale | | | | | | |
| Assignment for the | General Engineering Science (German program, | 7 semester): Specialisation Computer Scien | ce: Compulsory | | | |
| Following Curricula | | | | | | |
| | General Engineering Science (German program, | | | | | |
| | General Engineering Science (German progra | am, 7 semester): Specialisation Mechanic | cal Engineering, I | ocus Mechatroni | | |
| | Compulsory | - 7 | Fasia ania a Fas | Alara the Country | | |
| | General Engineering Science (German progra | m, / semester): Specialisation Mechanical | Engineering, Foo | us Aircraft Syste | | |
| | Engineering: Compulsory | | | | | |
| | General Engineering Science (German program | 7 semester): Specialisation Mechanical End | iineerina. Focus Th | eoretical Mechani | | |
| | General Engineering Science (German program, Engineering: Compulsory | 7 semester): Specialisation Mechanical Eng | jineering, Focus Th | eoretical Mechani | | |
| | General Engineering Science (German program, Engineering: Compulsory General Engineering Science (German progr | | | | | |
| | Engineering: Compulsory | | | | | |
| | Engineering: Compulsory General Engineering Science (German progr | am, 7 semester): Specialisation Mechan | ical Engineering, | Focus Materials | | |
| | Engineering: Compulsory General Engineering Science (German progr Engineering Sciences: Compulsory | am, 7 semester): Specialisation Mechan | ical Engineering, | Focus Materials | | |
| | Engineering: Compulsory General Engineering Science (German progr Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program | am, 7 semester): Specialisation Mechan , 7 semester): Specialisation Mechanical En | ical Engineering, gineering, Focus P | Focus Materials | | |
| | Engineering: Compulsory General Engineering Science (German progr Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program Compulsory | am, 7 semester): Specialisation Mechan , 7 semester): Specialisation Mechanical En n, 7 semester): Specialisation Mechanical | ical Engineering, gineering, Focus P Engineering, Foc | Focus Materials roduct Developme us Energy System | | |
| | Engineering: Compulsory General Engineering Science (German progr Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program | am, 7 semester): Specialisation Mechan , 7 semester): Specialisation Mechanical En n, 7 semester): Specialisation Mechanical | ical Engineering, gineering, Focus P Engineering, Foc | Focus Materials roduct Developm us Energy Syster | | |
| | Engineering: Compulsory General Engineering Science (German progr Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program Compulsory | am, 7 semester): Specialisation Mechan , 7 semester): Specialisation Mechanical En m, 7 semester): Specialisation Mechanical am, 7 semester): Specialisation Mechanica 7 semester): Specialisation Naval Architectu 7 semester): Specialisation Biomedical Engi 7 semester): Specialisation Bioprocess Engi 7 semester): Specialisation Electrical Engine | ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory eering: Compulsory | Focus Materials roduct Developm us Energy Syster ocus Biomechani | | |
| | Engineering: Compulsory General Engineering Science (German progr Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, General Engineering Science (German program, | am, 7 semester): Specialisation Mechan , 7 semester): Specialisation Mechanical En m, 7 semester): Specialisation Mechanical am, 7 semester): Specialisation Mechanical 7 semester): Specialisation Naval Architectu 7 semester): Specialisation Biomedical Engi 7 semester): Specialisation Bioprocess Engi 7 semester): Specialisation Electrical Engine 7 semester): Specialisation Green Technolo | ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory eering: Compulsory | Focus Materials roduct Developm us Energy Syster ocus Biomechani | | |
| | Engineering: Compulsory General Engineering Science (German progr Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, General Engineering Science (German program, | am, 7 semester): Specialisation Mechan , 7 semester): Specialisation Mechanical En m, 7 semester): Specialisation Mechanical am, 7 semester): Specialisation Mechanical 7 semester): Specialisation Naval Architectu 7 semester): Specialisation Biomedical Engi 7 semester): Specialisation Bioprocess Engi 7 semester): Specialisation Electrical Engine 7 semester): Specialisation Green Technolo | ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory eering: Compulsory | Focus Materials roduct Developm us Energy Syster ocus Biomechani | | |
| | Engineering: Compulsory General Engineering Science (German progr Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, General Engineering Science (German program, Compulsory Computer Science: Core Qualification: Compulsor | am, 7 semester): Specialisation Mechan , 7 semester): Specialisation Mechanical En m, 7 semester): Specialisation Mechanical am, 7 semester): Specialisation Mechanical 7 semester): Specialisation Naval Architectu 7 semester): Specialisation Biomedical Engin 7 semester): Specialisation Bioprocess Engi 7 semester): Specialisation Electrical Engine 7 semester): Specialisation Green Technolo | ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory eering: Compulsory | Focus Materials roduct Developm us Energy Syster ocus Biomechan yry ry | | |
| | Engineering: Compulsory General Engineering Science (German progr Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, General Engineering Science (German program, Compulsory Computer Science: Core Qualification: Compulsor Data Science: Core Qualification: Elective Comp Electrical Engineering: Core Qualification: Compu General Engineering Science (English program, | am, 7 semester): Specialisation Mechan , 7 semester): Specialisation Mechanical En m, 7 semester): Specialisation Mechanical am, 7 semester): Specialisation Mechanical am, 7 semester): Specialisation Naval Architectu 7 semester): Specialisation Biomedical Engin 7 semester): Specialisation Bioprocess Engi 7 semester): Specialisation Electrical Engine 7 semester): Specialisation Green Technolo amy Jasory Jasory Jasory Specialisation Civil Engineering | ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory gies, Focus Renew :: Compulsory | Focus Materials roduct Developm us Energy Syster ocus Biomechan my ry ry able Energy: Elect | | |
| | Engineering: Compulsory General Engineering Science (German progr Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program Compulsory General Engineering Science (German program, General Engineering Science (German program, Compulsory Computer Science: Core Qualification: Compulsor Data Science: Core Qualification: Elective Comp Electrical Engineering: Core Qualification: Compu | am, 7 semester): Specialisation Mechan , 7 semester): Specialisation Mechanical En m, 7 semester): Specialisation Mechanical am, 7 semester): Specialisation Mechanical am, 7 semester): Specialisation Naval Architectu 7 semester): Specialisation Biomedical Engin 7 semester): Specialisation Bioprocess Engi 7 semester): Specialisation Electrical Engine 7 semester): Specialisation Green Technolo amy Jasory Jasory Jasory Specialisation Civil Engineering | ical Engineering, gineering, Focus P Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory gies, Focus Renew :: Compulsory | Focus Materials roduct Developm us Energy System ocus Biomechan my ry ry able Energy: Elec | | |

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

| Course L0321: Computer Eng | jineering | | |
|----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 3 | | |
| CP | 4 | | |
| Workload in Hours | ependent Study Time 78, Study Time in Lecture 42 | | |
| Lecturer | Prof. Heiko Falk | | |
| Language | DE/EN | | |
| 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 Eng | ourse L0324: Computer Engineering | | |
|----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Prof. Heiko Falk | | |
| Language | DE/EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | | |
|---|---|--|---|---------------------------|-----------------|
| Title | | | Тур | Hrs/wk | СР |
| Materials and Process Modeling (L2 | 2862) | | Lecture | 3 | 3 |
| Materials Selection and Processing | (L2861) | | Lecture | 3 | 3 |
| Module Responsible | Prof. Norbert Huber | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | | | | | |
| Knowledge | | | | | |
| Educational Objectives | After taking part su | ccessfully, students ha | ve reached the following learning results | | |
| Professional Competence | | | | | |
| | are decisive for the applicability and economic efficiency. Metallic materials are in the foreground. Ceramics and polymers are covered in the sense of a broad range of available materials. In parallel to the material-technological consideration, the modeling of material behavior by means of phenomenological mat laws for plasticity under monotonic and cyclic loading is worked out. In addition to the evaluation of component behavior, plast also plays a major role in manufacturing processes and thus provides the basis for process simulation. Process models simulation methods for selected manufacturing processes, such as rolling or forming, are presented for this topic area. | | | | |
| Skills | | | | | |
| Personal Competence | | | | | |
| Social Competence | | | | | |
| Autonomy | , | | | | |
| Workload in Hours | Independent Study | Time 96, Study Time ir | Lecture 84 | | |
| Credit points | 6 | | | | |
| Course achievement | Compulsory Bonus Yes 20 % | Form Excercises | Description Wir stellen Übungsaufgaben (ÜA), den wöchentlichen Übungen vorg bis zu 20% bei der Prüfung berück | estellt werden. Diese kör | |
| | Written exam | | | | |
| Examination | | | | | |
| Examination Examination duration and | 120 min | | | | |
| | | | | | |
| Examination duration and | | ng Science (German | program, 7 semester): Specialisation M | lechanical Engineering, | Focus Materials |
| Examination duration and scale | General Engineerir | - | program, 7 semester): Specialisation M | lechanical Engineering, | Focus Materials |
| Examination duration and scale Assignment for the | General Engineerin Engineering Science | es: Compulsory | program, 7 semester): Specialisation M terials in Engineering Sciences: Compulsory | | Focus Materials |
| Examination duration and scale Assignment for the Following Curricula | General Engineerir Engineering Science Mechanical Enginee | es: Compulsory ering: Specialisation Ma | | | Focus Materials |
| Examination duration and scale Assignment for the Following Curricula Course L2862: Materials and | General Engineerir Engineering Science Mechanical Enginee | es: Compulsory ering: Specialisation Ma | | | Focus Materials |
| Examination duration and scale Assignment for the Following Curricula Course L2862: Materials and | General Engineerin Engineering Science Mechanical Engineer Process Modeling Lecture | es: Compulsory ering: Specialisation Ma | | | Focus Materials |

| СР | 3 |
|-------------------|---|
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Prof. Norbert Huber |
| Language | EN |
| Cycle | SoSe |
| Content | Relevance of plasticity in materials processing and operation Fundamentals of plasticity in metals and alloys Modellierung von Materialverhalten Plasticity in cyclic loading Rate dependency, recristallization Rolling, forming, and solid state joining processes Residual stress design |
| Literature | Hull and Bacon: Introduction to Dislocations (1984) G. Gottstein: Physik. Grundlagen der Materialk. (2001) P. Haupt: Cont. Mechanics and Theory of Materials (2002) N. Huber: Vorlesungsskript "Grundlagen der mechanischen Eigenschaften von Werkstoffen", TUHH |

| Course L2861: Materials Sele | ection and Processing | | | |
|------------------------------|--|--|--|--|
| Тур | Lecture | | | |
| Hrs/wk | 3 | | | |
| CP | 3 | | | |
| Workload in Hours | lependent Study Time 48, Study Time in Lecture 42 | | | |
| Lecturer | Prof. Kaline Pagnan Furlan | | | |
| Language | EN | | | |
| Cycle | SoSe | | | |
| Content | Introduction Overview of fabrication processes Shape considerations: macrostructural aspects Material properties: microstructural aspects Materials engineering: microstructure, shape and processing relation Materials engineering: function and costs relation | | | |
| Literature | M.F. Ashby, Materials Selection in Mechanical Design, 4thedition, Butterworth-Heinemann(2011) W.F. Gale and T.C. Totemeier, Smithells Metals Reference Book, 8thedition, Butterworth-Heinemann(2004) J. Beddoes and M. Bibby, Principles of Metal Manufacturing Processes, Butterworth-Heinemann(1999) | | | |

| Fieldie Filosof Liniti | nced Fundamentals of Materia | | | | | |
|---------------------------------|--|-------------------------|-----------------------------|---------------------------------------|-----------------------|--|
| Courses | | | | | | |
| Title | | | Тур | Hrs/wk | СР | |
| Enhanced Fundamentals: Ceramics | | | Lecture | 2 | 2 | |
| Enhanced Fundamentals: Ceramics | - | | Recitation Section (large) | 1 | 1 | |
| | anced Fundamentals: Metals (L1086) Lecture 2 3 | | | | | |
| Module Responsible | | | | | | |
| Admission Requirements | None | | | | | |
| | Module "Fundamentals of Materials Science | | | | | |
| Knowledge | Module "Materials Science Laboratory" | | | | | |
| | ·····, | | | | | |
| | | | | | | |
| | Module "Advanced Materials" | | | | | |
| Educational Objectives | After taking part successfully, students have | e reached the following | g learning results | | | |
| Professional Competence | | | | | | |
| | The students are able to give an enhanced | overview over the follo | wing topics | | | |
| | in metals, polymers and ceramics: Atomic | | | fects , electrical | and mass transpor | |
| | microstructure and phase diagrams. They a | | | | | |
| | | | | | | |
| | | | | | | |
| 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. | | | | | |
| | | | | | | |
| | | | | | | |
| | | n Lecture 70 | | | | |
| Credit points | | | | | | |
| Course achievement | | | | | | |
| Examination | Written exam | | | | | |
| Examination duration and | 180 min | | | | | |
| scale | | | | | | |
| Assignment for the | General Engineering Science (German p | orogram, 7 semester |): Specialisation Mechani | cal Engineering, | Focus Materials | |
| Following Curricula | Engineering Sciences: Compulsory | | | | | |
| | Data Science: Core Qualification: Elective Co | | | | | |
| | General Engineering Science (English progr | am, 7 semester): Spec | ialisation Mechanical Engin | eering, Focus Ma | terials in Engineerir | |
| | Sciences: Compulsory | | | | | |
| | General Engineering Science (English prog | ram, 7 semester): Spe | ecialisation Mechanical Eng | jineering, Focus F | Product Developme | |
| | and Production: Compulsory | | | | | |
| | Mechanical Engineering: Specialisation Mate | | | | | |
| | Technomathematics: Specialisation III. Engi | neering Science: Elect | ive Compulsory | | | |

| Course L1233: Enhanced Fun | idamentals: Ceramics and Polymers |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | |
| CP | |
| | Independent Study Time 32, Study Time in Lecture 28 |
| | Prof. Gerold Schneider, Prof. Robert Meißner |
| Language | DE/EN |
| Cycle | SoSe |
| Content | 1. 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 Bayer-Prozess zur AlzOs-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) |
| | 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 Ionenleiter |
| | lonische Leitfähigkeit |
| | Dotiertes Zirkonoxid in der Brennstoffzelle und Lambdasonde |
| Literature | D R H Jones, Michael F. Ashby, Engineering Materials 1, An Introduction to Properties, Applications 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 |
| | D. Munz, T. Fett, Ceramics, Springer, 2001 |
| | |
| | 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. Robert Meißner | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| se L1086: Enhanced Fur | Idamentals: Metals | | |
|------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | | | |
| CP | 3 | | |
| Workload in Hours | ndependent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | rof. Jörg Weißmüller | | |
| Language | | | |
| Cycle | | | |
| | | | |
| Content | Advanced understanding of metals: | | |
| | Physical materials properties | | |
| | Materials behaviour - elastic, thermal, electrical Superelasticity and change memory effect | | |
| | Superelasticity and shape memory effect Fundamentals of electrical conductivity in metals and semiconductors | | |
| | | | |
| | o Superconductivity | | |
| | Chemical (or "dry") corrosion | | |
| | Driving forces and mechanisms Bassivation | | |
| | o Passivation o Growth laws | | |
| | | | |
| | Introduction to electrochemistry | | |
| | o Electrolytes o lons | | |
| | o Solvatation | | |
| | o Dissolution and deposition of metals | | |
| | o Galvanic cells and cell voltage | | |
| | o Galvanic ceris and ceri voltage | | |
| | o Nernst equation | | |
| | o Polarizable electrodes | | |
| | | | |
| | Constitute and provides apositive processor | | |
| | Capacitive and pseudocapacitive processes Capacitive currents and Faraday currents | | |
| | Electrochemical (or "wet") corrosion and corrosion protection | | |
| | o Basic observations | | |
| | o Galvanic corrosion | | |
| | o Protection against galvanic corrosion | | |
| | o Stainless steel | | |
| | o sacrificial anodes | | |
| | o Passivation and Pourbaix diagrams | | |
| | o Corrosion through gas reduction | | |
| | o Crevice corrosion | | |
| | o Stress corrosion cracking | | |
| | o Alloy corrosion and nanoporous metals | | |
| | Electrochemical energy storage | | |
| | o How a battery works | | |
| | o Lead accumulators | | |
| | o Alkaline batteries | | |
| | o Nickel-metal hydride accumulators | | |
| | o Flux batteries | | |
| | o Lithium-ion accumulators | | |
| | o Electrolytic and super capacitors | | |
| | o Fuel cells | | |
| | Materials for hydrogen storage | | |
| | o Storage strategies | | |
| | Requirements for storage materials | | |
| | o State of the art | | |
| | Magnetism and magnetic materials | | |
| | o Phenomenology: magnetic field and magnetization | | |
| | Para-, ferro-, antiferromagnets; Curie transition | | |
| | Magnetism at the atomic scale; exchange coupling | | |
| | o Magnetization isotherms, domains | | |
| | o Measurement methods | | |
| | | | |

- o Measurement methods
- o Magnetocrystalline anisotropy and domain walls
- o Hard magnetic materials and their applications

| | o Soft magnetic materials and their applications |
|------------|---|
| Literature | - Vorlesungsskript |
| | - W.D. Callister, "Materialwissenschaften und Werkstofftechnik ", Wiley-VCH 2012 |
| | - Carl H. Hamann, Wolf Vielstich, "Elektrochemie", Wiley-VCH; 4. Auflage 2005 |
| | - Kurzweil, Dietlmeier, "Elektrochemische Speicher" Springer Vieweg (2015) |
| | (eBook: https://link.springer.com/book/10.1007/978-3-658-10900-4) |
| | - B. D. Cullity, C.D. Graham, "Introduction to magnetic materials", John Wiley & Sons, 2011 |
| | - D. Jiles, "Introduction to magnetism and magnetic materials", CRC press, 2015 |

| Module M0934: Advai | and Matarials | | | |
|--|---|--|-----------------------|------------------|
| Module M0954: Adval | | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Advanced Materials Characterizatio | n (L1087) | Lecture | 2 | 2 |
| Advanced Materials Design (L1091) | | Lecture | 2 | 2 |
| Advanced Materials Design (L1092) | | Recitation Section (large) | 2 | 2 |
| Module Responsible | Prof. Patrick Huber | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Fundamentals of Materials Science (I and II) |) | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students hav | ve reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students will be able to explain the properties of advanced materials along with their applications in technology, in particula metallic, ceramic, polymeric, semiconductor, modern composite materials (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 or modern materials science, which enables them to select optimum materials combinations depending on the technical applications. | | | |
| Personal Competence Social Competence | The students are able to present solutions to specialists and to develop ideas further. | | | |
| Autonomy | The students are able to | | | |
| | assess their own strengths and weak | knesses. | | |
| | define tasks independently. | | | |
| Workload in Hours | Independent Study Time 96, Study Time in | Lecture 84 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German p | program, 7 semester): Specialisation Mecha | nical Engineering, I | ocus Biomechanio |
| Following Curricula | | · | | |
| | General Engineering Science (German p | program, 7 semester): Specialisation Mech | anical Engineering, | Focus Materials |
| | Engineering Sciences: Compulsory | | | |
| | Data Science: Specialisation Materials Scien | nce: Compulsory | | |
| | General Engineering Science (English progr | ram, 7 semester): Specialisation Mechanical En | gineering: Elective C | Compulsory |
| | Mechanical Engineering: Core Qualification: | | | |

| 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: Advanced Materials Design | | |
|---|---|--|
| Тур | Lecture | |
| Hrs/wk | | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | rof. Patrick Huber, Prof. Stefan Fritz Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | | |
| Literature | Vorlesungsunterlagen | |

| 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 Fritz Müller, Prof. Patrick Huber, Prof. Gerold Schneider, Prof. Jörg Weißmüller | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

Ξ

Focus Mechatronics

| Module M0597: Adva | nced Mechanical Engineering D | esign | | |
|---------------------------------|---|---|-----------------------|---------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Advanced Mechanical Engineering | Design II (L0264) | Lecture | 2 | 2 |
| Advanced Mechanical Engineering | Design II (L0265) | Recitation Section (large) | 2 | 1 |
| Advanced Mechanical Engineering | | Lecture | 2 | 2 |
| Advanced Mechanical Engineering | Design I (L0263) | Recitation Section (large) | 2 | 1 |
| Module Responsible | Prof. Dieter Krause | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | | ng Design | | |
| | Mechanics | | | |
| | Fundamentals of Materials Science | | | |
| | Production Engineering | | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning results | | |
| Professional Competence | 51 5. | 5 5 | | |
| | After passing the module, students are able t | 0. | | |
| Knowledge | After pussing the module, students are use t | | | |
| | explain complex working principles and | d functions of machine elements and of basic e | elements of fluidics, | , |
| | explain requirements, selection criteria | a, application scenarios and practical examples | of complex maching | ne elements, |
| | indicate the background of dimensioni | ng calculations. | | |
| Chille | After passing the module, students are able t | | | |
| SKIIIS | After passing the module, students are able t | 0: | | |
| | accomplish dimensioning calculations | of covered machine elements, | | |
| | • transfer knowledge learned in the mod | lule to new requirements and tasks (problem s | olving skills), | |
| | recognize the content of technical draw | vings and schematic sketches, | | |
| | • evaluate complex designs, technically | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to discuss technical | information in the lecture supported by actival | ring methods | |
| | • Students are use to discuss technical | mornation in the lecture supported by activat | ing methods. | |
| Autonomy | | | | |
| | | epen their acquired knowledge in exercises. | | |
| | | al knowledge and to recapitulate poorly unde | rstood content e.g | . by using the vid |
| | recordings of the lectures. | | | |
| Workload in Hours | Independent Study Time 68, Study Time in Le | ecture 112 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 | | | |
| scale | | | | |
| | | | <u> </u> | |
| Assignment for the | | m, 7 semester): Specialisation Mechanical Eng | | - |
| Following Curricula | | gram, 7 semester): Specialisation Mechani | cal Engineering, F | ocus Biomechani |
| | Compulsory | | | |
| | | ram, 7 semester): Specialisation Mechanica | Engineering, Foc | us Energy Syster |
| | Compulsory | | | |
| | General Engineering Science (German prog | gram, 7 semester): Specialisation Mechanica | l Engineering, Foc | us Aircraft Syste |
| | Engineering: Compulsory | | | |
| | 5 5 1 | ogram, 7 semester): Specialisation Mechar | nical Engineering, | Focus Materials |
| | Engineering Sciences: Compulsory | | | |
| | General Engineering Science (German pro | gram, 7 semester): Specialisation Mechani | cal Engineering, F | Focus Mechatroni |
| | Compulsory | | | |
| | General Engineering Science (German progra | am, 7 semester): Specialisation Mechanical Er | ngineering, Focus P | Product Developme |
| | and Production: Compulsory | | | |
| | General Engineering Science (German progra | m, 7 semester): Specialisation Mechanical En | gineering, Focus Th | eoretical Mechani |
| | Engineering: Compulsory | | | |
| | Energy Systems: Technical Complementary C | Course Core Studies: Elective Compulsory | | |
| | Engineering Science: Specialisation Mechanic | al Engineering: Compulsory | | |
| | General Engineering Science (English program | n, 7 semester): Specialisation Mechanical Engi | neering: Compulso | ry |
| | | gram, 7 semester): Specialisation Mechanic | | |
| | Compulsory | · | | |
| | | ram, 7 semester): Specialisation Mechanical | Engineering, Foc | us Energy Syster |
| | Compulsory | · | J | 5, 2,220 |
| | | ram, 7 semester): Specialisation Mechanica | l Engineering. Foc | us Aircraft Syste |
| | La casa ang serence (English prog | , | | |
| | Engineering: Compulsory | | | |
| | Engineering: Compulsory General Engineering Science (English program | n. 7 semester): Specialisation Mechanical Eng | neering. Focus Mat | terials in Engineer |
| | General Engineering Science (English program | n, 7 semester): Specialisation Mechanical Eng | ineering, Focus Mat | terials in Engineer |
| | | n, 7 semester): Specialisation Mechanical Eng | ineering, Focus Mat | terials in Engineer |

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.

| C | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: | |
|---|--|--|
| C | Compulsory | |
| C | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development | |
| a | and Production: Compulsory | |
| C | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical | |
| E | Engineering: Compulsory | |
| Ν | Mechanical Engineering: Core Qualification: Compulsory | |
| Ν | Naval Architecture: Core Qualification: Compulsory | |

| Course L0264: Advanced Me | chanical Engineering Design II | | |
|---------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| CP | 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 | | |
| | 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. | | |
| | Sowie weitere Bücher zu speziellen Themen | | |

| 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 |

| Hrs/wk | |
|-------------------|---|
| | 2 |
| CP | 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 |
| 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 |
| | 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, akt |
| | 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 |
| Circuit Theory (L0566) | | Lecture | 3 | 4 |
| Circuit Theory (L0567) | | Recitation Section (small) | 2 | 2 |
| Module Responsible | Prof. Alexander Kölpin | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Electrical Engineering I and II, Mathematics I an | d II | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have rea | ached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to explain the basic method | s for calculating electrical circuits. They kno | w the Fourier ser | ies analysis of line |
| | networks driven by periodic signals. They kno | w the methods for transient analysis of line | ar networks in tir | me and in frequen |
| | domain, and they are able to explain the freque | ncy behaviour and the synthesis of passive to | vo-terminal-circui | ts. |
| | | | | |
| | | | | |
| Skills | The students are able to calculate currents an | | | |
| | periodic signals. They are able to calculate tran | | | |
| | respective transient behaviour. They are able | to analyse and to synthesize the frequenc | y behaviour of p | assive two-termin |
| | circuits. | | | |
| | | | | |
| Devecuel Competence | | | | |
| Personal Competence | Students work on eversise tacks in small qui | led groups. They are encouraged to proceed | t and discuss the | ir roculte within t |
| Social Competence | Students work on exercise tasks in small guid group. | led groups. They are encouraged to presen | t and discuss the | er results within t |
| | group. | | | |
| | | | | |
| Autonomy | The students are able to find out the required r | methods for solving the given practice proble | ms Possibilities a | re given to test the |
| Autonomy | knowledge during the lectures continuously | | | |
| | educational objectives. They can link their gaine | | | |
| | | | | |
| | | | | |
| | Independent Study Time 110, Study Time in Lee | cture 70 | | |
| Credit points | | | | |
| Course achievement | | | | |
| | Written exam | | | |
| Examination duration and | 150 min | | | |
| scale | Consul Engineering Colones (Corners areas | and 7 competer). Cresislication Mechanic | | Tagua Machatrania |
| | General Engineering Science (German progr | ani, / semester): specialisation Mechanic | ar Engineering, | rocus mechaironio |
| Following Curricula | General Engineering Science (German program | 7 semester): Specialisation Electrical Engine | erina: Compulsor | 1 |
| | Electrical Engineering: Core Qualification: Comp | | cring. compuisor | 7 |
| | Engineering Science: Specialisation Electrical En | • | | |
| | General Engineering Science (English progra | | al Engineering. | Focus Mechatronio |
| | Compulsory | | 557 | |
| | Computational Science and Engineering: Specia | lisation II. Mathematics & Engineering Scienc | e: Elective Compu | Ilsory |
| | Mechatronics: Core Qualification: Compulsory | | | - |
| | Technomathematics: Specialisation III. Engineer | ing Science: Elective Compulsory | | |

| Course L0566: Circuit Theory | |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Arne Jacob, Dr. Fabian Lurz |
| 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 | urse L0567: Circuit Theory | | |
|------------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Arne Jacob, Dr. Fabian Lurz | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | see interlocking course | | |
| Literature | siehe korrespondierende Lehrveranstaltung | | |
| | see interlocking course | | |

| Courses | | | | | |
|-----------------------------------|---|--|----------------------|----------------------|--|
| Title | | Тур | Hrs/wk | СР | |
| Simulation and Design of Mechatro | nic Systems (L1822) | Lecture | 2 | 2 | |
| Simulation and Design of Mechatro | nic Systems (L1823) | Recitation Section (large) | 1 | 2 | |
| Simulation and Design of Mechatro | nic Systems (L1824) | Practical Course | 1 | 2 | |
| Module Responsible | NN | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Fundatmentals of mechanics, control theory an | d electrical engineering | | | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students have re- | ached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | Students are able to describe methods and calc | ulations for design, modeling, simulation ar | nd optimization of n | mechatronic systen | |
| Skills | Students are able to apply modern algorithms f | or modeling of mechatronic systems. They | can identify simula | ate and design sim | |
| JKIIIS | systems and implement those in laboratory con | | can lacitary, simula | ace und design silli | |
| | systems and implement close in laboratory con | | | | |
| Personal Competence | | | | | |
| Social Competence | Students are able to work goal-oriented in smal | I mixed groups and present results to targe | t groups. | | |
| Autonomy | Students are able to recognize and improve kno | Students are able to recognize and improve knowledge deficits independently. | | | |
| | With instructor assistance, students are able to | evaluate their own knowledge level and de | fine a further cours | e of study. | |
| Workload in Hours | Independent Study Time 124, Study Time in Le | cture 56 | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and | 90 min | | | | |
| scale | | | | | |
| Assignment for the | General Engineering Science (German program | , 7 semester): Specialisation Mechanical Er | ngineering, Focus M | lechatronics: Elect | |
| Following Curricula | Compulsory | | | | |
| | General Engineering Science (German progra | m, 7 semester): Specialisation Mechanica | al Engineering, Fo | cus Aircraft Syste | |
| | Engineering: Elective Compulsory | | | | |
| | Digital Mechanical Engineering: Core Qualificati | on: Compulsory | | | |
| | General Engineering Science (English program, | 7 semester): Specialisation Mechanical En | gineering, Focus Tl | heoretical Mechani | |
| | Engineering: Elective Compulsory | | | | |
| | General Engineering Science (English progra | m, 7 semester): Specialisation Mechanica | al Engineering, Foo | cus Aircraft Syste | |
| | Engineering: Elective Compulsory | | | | |
| | General Engineering Science (English program | , 7 semester): Specialisation Mechanical Er | igineering, Focus M | lechatronics: Elect | |
| | Compulsory | | | | |
| | Mechanical Engineering: Specialisation Theoret | ical Mechanical Engineering: Elective Comp | ulsory | | |
| | Mechanical Engineering: Specialisation Aircraft | | - | | |
| | Mechanical Engineering: Specialisation Aircraft | | | | |
| | Mechanical Engineering: Specialisation Mechatr | | | | |
| | Mechanical Engineering: Specialisation Mechatr | | | | |
| | Mechatronics: Core Qualification: Compulsory | · · · · · · · · · · · · · · · · · · · | | | |
| | Mechatronics: Core Qualification: Compulsory | | | | |

| Course L1822: Simulation and Design of Mechatronic Systems | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | NN | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Mechatronic Design | |
| | Modeling | |
| | Model Identifikation | |
| | Numerical Methods in simulation | |
| | Applications and examples in Matlab $^{\circledast}$ and Simulink $^{\circledast}$ | |
| Literature | Skript zur Veranstaltung | |
| | Weitere Literatur in der Veranstaltung | |

| Course L1823: Simulation an | ourse L1823: Simulation and Design of Mechatronic Systems | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | NN | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |
| | | | |
| Course L1824: Simulation an | nd 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 | NN |
|------------|-------------------------|
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Module M0730: Comp | | | | | |
|--|---|---|---|---|---|
| Courses | | | | | |
| Title | | | Тур | Hrs/wk | СР |
| Computer Engineering (L0321) Computer Engineering (L0324) | | | Lecture Recitation Section (small) | 3 1 | 4 |
| Module Responsible | Prof Heiko Falk | | Nectation Section (small) | ± | Z |
| Admission Requirements | None | | | | |
| | Basic knowledge in electrical | engineering | | | |
| Knowledge | | 5 5 | | | |
| Educational Objectives | After taking part successfully, | students have reached the | following learning results | | |
| Professional Competence | | | | | |
| Knowledge | programming down to gates. | | ality of computing systems. It con lowing topics: | vers the layers fron | n the assembly-le |
| | Sequential logic: Flip-flu Technological foundation Computer arithmetic: In Basics of computer arcs | ps, automata, systematic ł ns teger addition, subtraction itecture: Programming mo | , multiplication and division dels, MIPS single-cycle architectur | | works |
| | - | archies, SRAM, DRAM, cach ne perspective of the CPU, | nes principles of passing data, point-to | o-point connections, | busses |
| Skills | composition of computer syst collection of few and simple of today's computing systems - 1 After successful completion of system and the software exect on the hardware-centric abstr | ems. The students can ana omponents. They are able rom gates and circuits up t f the module, the student uted on it. In particular, th action layers from the asse | ect's perspective, i.e., they identif yze, how highly specific and indiv to distinguish between and to ex o complete processors. s are able to judge the interdepe ey shall understand the conseque embly language down to gates. The entire system's performance and t | idual computers car cplain the different endencies between ences that the exect is way, they will be | n be built based of abstraction layer a physical compo- ution of software enabled to evalu |
| | the impact that these low uss | | indre system s performance and e | | prioris. |
| Personal Competence | | | | | |
| Social Competence | Students are able to solve sim | ilar problems alone or in a | group and to present the results a | iccordingly. | |
| 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 | | | | |
| Course achievement | Compulsory Bonus Form | Descri | otion | | |
| F | Yes 10 % Excerc | ses | | | |
| | written exam | and labe | | | |
| Examination | 00 minutes, contents of cours | | | | |
| Examination duration and | 90 minutes, contents of cours | | | | |
| Examination duration and scale | | German program, 7 semes | ter): Specialisation Computer Scie | nce: Compulsory | |
| Examination duration and scale Assignment for the | General Engineering Science | | ter): Specialisation Computer Scie ter): Specialisation Civil Engineeri | | |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science (| German program, 7 semes | ter): Specialisation Computer Scie ter): Specialisation Civil Engineeri ter): Specialisation Process Engine | ng: Compulsory | |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science (General Engineering Science (| German program, 7 semes German program, 7 semes | ter): Specialisation Civil Engineeri | ng: Compulsory eering: Compulsory | Focus Mechatron |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science (General Engineering Science (| German program, 7 semes German program, 7 semes | ter): Specialisation Civil Engineeri ter): Specialisation Process Engine | ng: Compulsory eering: Compulsory | Focus Mechatron |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science Compulsory General Engineering Science | German program, 7 semes German program, 7 semes (German program, 7 s | ter): Specialisation Civil Engineeri ter): Specialisation Process Engine | ng: Compulsory eering: Compulsory ical Engineering, I | |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science Compulsory General Engineering Science Engineering: Compulsory | German program, 7 semes German program, 7 semes (German program, 7 se (German program, 7 ser | ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechan nester): Specialisation Mechanica | ng: Compulsory eering: Compulsory ical Engineering, f al Engineering, Foc | us Aircraft Syste |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science Compulsory General Engineering Science Engineering: Compulsory General Engineering Science | German program, 7 semes German program, 7 semes (German program, 7 se (German program, 7 ser | ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechan | ng: Compulsory eering: Compulsory ical Engineering, f al Engineering, Foc | us Aircraft Syste |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science) Compulsory General Engineering Science Engineering: Compulsory General Engineering Science (Engineering: Compulsory | German program, 7 semes German program, 7 semes (German program, 7 se (German program, 7 sen German program, 7 semes | ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechan nester): Specialisation Mechanica ter): Specialisation Mechanical En | ng: Compulsory eering: Compulsory ical Engineering, f al Engineering, Focus Th igineering, Focus Th | us Aircraft Syste |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science) Compulsory General Engineering Science Engineering: Compulsory General Engineering Science (Engineering: Compulsory | German program, 7 semes German program, 7 semes (German program, 7 se (German program, 7 semes German program, 7 semes e (German program, 7 s | ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechan nester): Specialisation Mechanica | ng: Compulsory eering: Compulsory ical Engineering, f al Engineering, Focus Th igineering, Focus Th | us Aircraft Syste |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering Science) (Engine | German program, 7 semes German program, 7 semes (German program, 7 se (German program, 7 ser German program, 7 semes e (German program, 7 s sory | ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechan nester): Specialisation Mechanica ter): Specialisation Mechanical En | ng: Compulsory eering: Compulsory ical Engineering, F al Engineering, Foc gineering, Focus Th nical Engineering, | us Aircraft Syste neoretical Mechan Focus Materials |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering Sciences: Compu General Engineering Science (and Production: Compulsory | German program, 7 semes German program, 7 semes (German program, 7 se (German program, 7 ser German program, 7 semes e (German program, 7 seme sory German program, 7 seme | ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechan nester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mecha ster): Specialisation Mechanical E | ng: Compulsory eering: Compulsory ical Engineering, F al Engineering, Foc gineering, Focus Th nical Engineering, ngineering, Focus P | us Aircraft Syste neoretical Mechan Focus Materials Product Developm |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering Sciences: Compu General Engineering Science and Production: Compulsory General Engineering Science (Compulsory | German program, 7 semes German program, 7 semes (German program, 7 ser (German program, 7 ser German program, 7 semes sory German program, 7 seme (German program, 7 seme | ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechan nester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mecha ster): Specialisation Mechanical E nester): Specialisation Mechanical E | ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Foc | us Aircraft Syste neoretical Mechan Focus Materials Product Developm us Energy Syste |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering Sciences: Compu General Engineering Science and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science Compulsory | German program, 7 semes German program, 7 semes (German program, 7 ser (German program, 7 ser German program, 7 semes sory German program, 7 seme (German program, 7 seme (German program, 7 ser | ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechanica nester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanica emester): Specialisation Mechanica | ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Foc ical Engineering, Foc | us Aircraft Syste neoretical Mechan Focus Materials Product Developm us Energy Syste |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering Sciences: Compu General Engineering Science and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science | German program, 7 semes German program, 7 semes (German program, 7 ser (German program, 7 ser German program, 7 semes sory German program, 7 seme (German program, 7 sem (German program, 7 sem German program, 7 semes | ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechanica nester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanica emester): Specialisation Mechanica | ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Foc ical Engineering, Foc | us Aircraft Syste neoretical Mechan Focus Materials Product Developm us Energy Syste Focus Biomechan |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering Sciences: Compul General Engineering Science and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science (General Engineering Science (| German program, 7 semes German program, 7 semes (German program, 7 ser (German program, 7 ser German program, 7 semes sory German program, 7 seme (German program, 7 sem (German program, 7 semes German program, 7 semes | ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechanica nester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanica emester): Specialisation Mechanica emester): Specialisation Mechanica emester): Specialisation Mechanica | ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Foc ical Engineering, Foc ture: Compulsory gineering: Compulsor | us Aircraft Syste leoretical Mechan Focus Materials Product Developm us Energy Syste Focus Biomechan |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering Sciences: Compul General Engineering Science and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science General Engineering Science (General Engineering Science (General Engineering Science (| German program, 7 semes German program, 7 semes (German program, 7 ser (German program, 7 ser German program, 7 semes e (German program, 7 seme (German program, 7 seme (German program, 7 seme German program, 7 semes German program, 7 semes German program, 7 semes German program, 7 semes German program, 7 semes | ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechanica nester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanica emester): Specialisation Mechanica emester): Specialisation Mechanica ter): Specialisation Naval Architec ter): Specialisation Biomedical Engi ter): Specialisation Bioprocess Engi ter): Specialisation Electrical Engi | ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Foc ical Engineering, Foc ture: Compulsory gineering: Compulsory neering: Compulsory | eus Aircraft Syste leoretical Mechan Focus Materials Product Developm us Energy Syste Focus Biomechan |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science) Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering Sciences: Compul General Engineering Science and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (| German program, 7 semes German program, 7 semes (German program, 7 ser (German program, 7 ser German program, 7 semes e (German program, 7 seme (German program, 7 seme (German program, 7 seme German program, 7 semes German program, 7 semes German program, 7 semes German program, 7 semes German program, 7 semes | ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mechanical En semester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanical emester): Specialisation Mechanica emester): Specialisation Mechanica ter): Specialisation Naval Architec ter): Specialisation Biomedical Engi ter): Specialisation Biomedical Engi | ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Foc ical Engineering, Foc ture: Compulsory gineering: Compulsory neering: Compulsory | eus Aircraft Syste leoretical Mechan Focus Materials Product Developm us Energy Syste Focus Biomechan |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering Sciences: Compul General Engineering Science and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science General Engineering Science General Engineering Science General Engineering Science (General Engineering Science (| German program, 7 semes German program, 7 semes (German program, 7 semes (German program, 7 ser German program, 7 semes e (German program, 7 seme (German program, 7 seme (German program, 7 semes German program, 7 semes | ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechanica nester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanica emester): Specialisation Mechanica emester): Specialisation Mechanica ter): Specialisation Naval Architec ter): Specialisation Biomedical Engi ter): Specialisation Bioprocess Engi ter): Specialisation Electrical Engi | ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Foc ical Engineering, Foc ture: Compulsory gineering: Compulsory neering: Compulsory | eus Aircraft Syste leoretical Mechan Focus Materials Product Developm us Energy Syste Focus Biomechan |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering Sciences: Compul General Engineering Science and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science General Engineering Science General Engineering Science General Engineering Science (General | German program, 7 semes German program, 7 semes (German program, 7 semes (German program, 7 ser German program, 7 semes e (German program, 7 semes sory German program, 7 seme (German program, 7 semes German program, 7 semes | ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechanica nester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanica emester): Specialisation Mechanica emester): Specialisation Mechanica ter): Specialisation Naval Architec ter): Specialisation Biomedical Engi ter): Specialisation Bioprocess Engi ter): Specialisation Electrical Engi | ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Foc ical Engineering, Foc ture: Compulsory gineering: Compulsory neering: Compulsory | eus Aircraft Syste leoretical Mechan Focus Materials Product Developm us Energy Syste Focus Biomechan |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering Sciences: Compul General Engineering Science and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science General Engineering Science General Engineering Science General Engineering Science (General Engineering Science (| German program, 7 semes German program, 7 semes (German program, 7 semes (German program, 7 ser German program, 7 semes e (German program, 7 semes sory German program, 7 seme (German program, 7 semes German program, 7 semes | ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechanica nester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanica emester): Specialisation Mechanica emester): Specialisation Mechanica ter): Specialisation Naval Architec ter): Specialisation Biomedical Engi ter): Specialisation Bioprocess Engi ter): Specialisation Electrical Engi | ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Foc ical Engineering, Foc ture: Compulsory gineering: Compulsory neering: Compulsory | eus Aircraft Syste leoretical Mechan Focus Materials Product Developm us Energy Syste Focus Biomechan |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science) General Engineering Science (General Engineering Science) General Engineering Science Engineering: Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering Sciences: Compul General Engineering Science and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science General Engineering Science General Engineering Science General Engineering Science General Engineering Science (General Engineering Science (Gompulsory Computer Science: Core Qualificati Electrical Engineering: Core Q General Engineering Science (| German program, 7 semes German program, 7 semes (German program, 7 semes (German program, 7 ser German program, 7 semes e (German program, 7 semes sory German program, 7 seme (German program, 7 semes German program, 7 semes | ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechanica ter): Specialisation Mechanical En ter): Specialisation Mechanical En semester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanica emester): Specialisation Mechanica ter): Specialisation Mechanica ter): Specialisation Mechanica ter): Specialisation Biomedical Engi ter): Specialisation Electrical Engineeri ter): Specialisation Green Technol | ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Focus cal Engineering, Foc ical Engineering, Foc gineering: Compulsory gineering: Compulsory ogies, Focus Renew g: Compulsory | eus Aircraft Syste leoretical Mechar Focus Materials Product Developm us Energy Syste Focus Biomechar Ory Y able Energy: Elec |
| Examination duration and scale Assignment for the | General Engineering Science (General Engineering Science) General Engineering Science (General Engineering Science) Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering: Compulsory General Engineering Science Engineering Sciences: Compul General Engineering Science and Production: Compulsory General Engineering Science Compulsory General Engineering Science Compulsory General Engineering Science General Engineering Science General Engineering Science General Engineering Science General Engineering Science General Engineering Science (General Engin | German program, 7 semes German program, 7 semes (German program, 7 semes (German program, 7 ser German program, 7 semes e (German program, 7 semes sory German program, 7 seme (German program, 7 seme (German program, 7 semes German program, 7 semest (cation: Compulsory English program, 7 semest | ter): Specialisation Civil Engineeri ter): Specialisation Process Engine emester): Specialisation Mechanica nester): Specialisation Mechanica ter): Specialisation Mechanical En semester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanical E nester): Specialisation Mechanica emester): Specialisation Mechanica ter): Specialisation Mechanica ter): Specialisation Naval Architec ter): Specialisation Biomedical Engi ter): Specialisation Electrical Engi ter): Specialisation Green Technol | ng: Compulsory eering: Compulsory ical Engineering, Foc al Engineering, Focus Th nical Engineering, ngineering, Focus P al Engineering, Focus P al Engineering, Foc ical Engineering, Foc ical Engineering, Foc gineering: Compulsory gineering: Compulsory ogies, Focus Renew g: Compulsory cal Engineering, F | eoretical Mechan Focus Materials Product Developm us Energy Syste Focus Biomechan ory yry able Energy: Elect |

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

| Course L0321: Computer Eng | jineering |
|----------------------------|---|
| 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/EN |
| 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 Eng | ourse L0324: Computer Engineering | | |
|----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 1 | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Prof. Heiko Falk | | |
| Language | DE/EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | |
|---------------------------------|--|--|---|---|
| Title | | Тур | Hrs/wk | СР |
| Numerical Mathematics I (L0417) | | Lecture | 2 | 3 |
| Numerical Mathematics I (L0418) | | Recitation Section (small) | 2 | 3 |
| Module Responsible | Prof. Sabine Le Borne | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mathematik I + II for Engineering Students (| german or english) or Analysis & Linear Alg | gebra I + II for Te | chnomathematic |
| Knowledge | basic MATLAB/Python knowledge | ,,, | <u> </u> | |
| | | | | |
| - | After taking part successfully, students have reach | ed the following learning results | | |
| Professional Competence | | | | |
| Knowleage | Students are able to | | | |
| | name numerical methods for interpolation, i | ntegration, least squares problems, eigenv | value problems, r | onlinear root fin |
| | problems and to explain their core ideas, | | | |
| | repeat convergence statements for the num | erical methods, | | |
| | explain aspects for the practical execution or | f numerical methods with respect to comp | utational and sto | rage complexitx. |
| | | | | |
| | | | | |
| Skills | Students are able to | | | |
| | implement, apply and compare numerical m | ethods using MATLAB/Pvthon. | | |
| | justify the convergence behaviour of numeri | | nd solution algori | ithm, |
| | select and execute a suitable solution approx | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to | | | |
| | work together in heterogeneously composed | teams (i.e., teams from different study p | rograms and bac | kground knowled |
| | explain theoretical foundations and support | | | |
| | | | | |
| Autonomy | Students are capable | | | |
| | to assess whether the supporting theoretical | and practical excercises are better solved | l individually or ir | ı a team, |
| | to assess their individual progess and, if nec | | | |
| | | | | |
| | Independent Study Time 124, Study Time in Lectur | e 56 | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 minutes | | | |
| scale | | | | |
| | General Engineering Science (German program, 7 s | | | |
| Following Curricula | General Engineering Science (German program | i, 7 semester): Specialisation Mechanic | al Engineering, | Focus Material |
| | Engineering Sciences: Compulsory | | e e nimero Como e de | |
| | General Engineering Science (German program, 7 s | | | |
| | General Engineering Science (German program, Compulsory | , v semester). Specialisation Mechanica | i Eligineering, r | ocus biomecnai |
| | General Engineering Science (German program, 7 | semester): Specialisation Mechanical Engi | peering Focus Th | enetical Mecha |
| | Engineering: Compulsory | semestery, specialisation ricchanical Eligi | | Corecicui Mecildi |
| | General Engineering Science (German program, | 7 semester): Specialisation Mechanical | Engineering. For | us Aircraft Svst |
| | | , special contraction free and the | J | |
| | Engineering. Elective Compulsorv | | | ochotropics, Elo |
| | Engineering: Elective Compulsory General Engineering Science (German program, 7 | semester): Specialisation Mechanical Engi | neering, Focus M | echacionics. Elec |
| | | semester): Specialisation Mechanical Engi | neering, Focus M | echacionics. Elec |
| | General Engineering Science (German program, 7 | | | |
| | General Engineering Science (German program, 7 Compulsory | | | |
| | General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, | 7 semester): Specialisation Mechanical I | Engineering, Foc | |
| | General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulse | Engineering, Foc | |
| | General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory | Engineering, Foc | |
| | General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory | Engineering, Foc | |
| | General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso | Engineering, Foc | |
| | General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective (Engineering Science: Core Qualification: Compulsor) | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory | Engineering, Foc | |
| | General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective (Engineering Science: Core Qualification: Compulsor) Engineering Science: Core Qualification: Compulsor | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory Y | Engineering, Foc | |
| | General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective (Engineering Science: Core Qualification: Compulsor) Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 so | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory Y Y emester): Core Qualification: Compulsory | Engineering, Foc ory ory | |
| | General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective (Engineering Science: Core Qualification: Compulsor) Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 sc General Engineering Science (English program, 7 sc | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory Y Y emester): Core Qualification: Compulsory emester): Specialisation Computer Science | Engineering, Foc ory ory :: Compulsory | us Energy Syste |
| | General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective (Engineering Science: Core Qualification: Compulsor) Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 sc General Engineering Science (English program, 7 sc General Engineering Science (English program, 7 sc General Engineering Science (English program, 7 sc | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulso Compulsory Y Y emester): Core Qualification: Compulsory emester): Specialisation Computer Science | Engineering, Foc ory ory :: Compulsory | us Energy Syste |
| | General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective (Engineering Science: Core Qualification: Compulsor) Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, Compulsory | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor Compulsory Y Y emester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical | Engineering, Foc ory ory :: Compulsory I Engineering, F | us Energy Syste |
| | General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective (Engineering Science: Core Qualification: Compulsor) Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 sc General Engineering Science (English program), 7 sc General Engineering Science | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor Compulsory Y Y emester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical | Engineering, Foc ory ory :: Compulsory I Engineering, F | us Energy Syste |
| | General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective (Engineering Science: Core Qualification: Compulsor) Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 sc General Engineering Science (English program, 7 sc General Engineering Science (English program, Compulsory General Engineering Science (English program, 7 sc Sciences: Compulsory | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor Compulsory Y Y emester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine | Engineering, Foc ory :: Compulsory I Engineering, F eering, Focus Mat | us Energy Syste Focus Biomechai terials in Enginee |
| | General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective (Engineering Science: Core Qualification: Compulsor) Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, Compulsory General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor Compulsory Y Y emester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine | Engineering, Foc ory :: Compulsory I Engineering, F eering, Focus Mat | us Energy Syste Focus Biomechai terials in Enginee |
| | General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective G Engineering Science: Core Qualification: Compulsor Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor Compulsory Y Y emester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical emester): Specialisation Mechanical Engine semester): Specialisation Mechanical Engine | Engineering, Foc pry cry cry E Compulsory E Engineering, F eering, Focus Mat eeering, Focus Th | us Energy Syste Focus Biomechan terials in Enginee neoretical Mechan |
| | General Engineering Science (German program, 7 Compulsory General Engineering Science (German program, Elective Compulsory Bioprocess Engineering: Specialisation A - General Computer Science: Specialisation Computational M Computer Science: Specialisation II. Mathematics a Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective (Engineering Science: Core Qualification: Compulsor) Engineering Science: Core Qualification: Compulsor General Engineering Science (English program, 7 General Engineering Science (English program, 7 General Engineering Science (English program, Compulsory General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory General Engineering Science (English program, 7 Sciences: Compulsory | 7 semester): Specialisation Mechanical I Bioprocess Engineering: Elective Compulso athematics: Elective Compulsory nd Engineering Science: Elective Compulsor Compulsory Y Y emester): Core Qualification: Compulsory emester): Specialisation Computer Science 7 semester): Specialisation Mechanical Engine semester): Specialisation Mechanical Engine | Engineering, Foc pry cry cry cry cry compulsory compulsory cering, Focus Mat heering, Focus Th eering: Compulso | us Energy Syste Focus Biomechai terials in Enginee neoretical Mechai |

Computational Science and Engineering: Core Qualification: Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Mechanical Engineering: Specialisation Mechatronics: Elective Compulsory

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

Process Engineering: Specialisation Process Engineering: Elective Compulsory

| Course L0417: Numerical Ma | thematics I | | |
|----------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| CP | | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Sabine Le Borne | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss quadrature, adaptive quadrature | | |
| Literature | Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer | | |

| Course L0418: Numerical Ma | rse L0418: Numerical Mathematics I | | |
|----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| CP | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Sabine Le Borne, Dr. Jens-Peter Zemke | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | |
|-------------------------------------|---|--|-----------------------|----------------------|
| Title | | Тур | Hrs/wk | CP |
| Electrical Machines and Actuators (| L0293) | Lecture | 3 | 4 |
| Electrical Machines and Actuators (| L0294) | Recitation Section (large) | 2 | 2 |
| Module Responsible | Prof. Thorsten Kern | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basics of mathematics, in particular comp | lexe numbers, integrals, differentials | | |
| Knowledge | Basics of electrical engineering and mech | anical engineering | | |
| Educational Objectives | After taking part successfully, students ha | ve reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students can to draw and explain the basi | c principles of electric and magnetic fields. | | |
| | They can describe the function of the | standard trucc of clastic mashings and pro | cont the correspond | dina aquationa a |
| | - | standard types of electric machines and pre- rives they can explain the major parameters of the | | |
| | from the power grid to the driven engine. | ives they can explain the major parameters of th | le energy eniciency | of the whole syste |
| | | | | |
| Skills | Students are able to calculate two-dimen | sional electric and magnetic fields in particular | ferromagnetic circo | uits with air gap. I |
| | this they apply the usual methods of the c | lesign auf electric machines. | | |
| | They can calulate the operational perform | nance of electric machines from their given cha | aracteristic data and | d selected quantit |
| | | usual equivalent circuits and graphical methods. | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | none | | | |
| Autonomy | Students are able independently to calcul | ate electric and magnatic fields for applications. | They are able to an | nalyse independer |
| | the operational performance of electric machines from the charactersitic data and theycan calculate thereof selected quantiti | | | |
| | and characteristic curves. | | | |
| | | | | |
| | | | | |
| Workload in Hours | Independent Study Time 110, Study Time | in Lecture 70 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Subject theoretical and practical work | | | |
| Examination duration and | Design of four machines and actuators, re | view of design files | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German pro | gram, 7 semester): Specialisation Electrical Engi | neering: Elective Co | mpulsory |
| Following Curricula | General Engineering Science (German p | rogram, 7 semester): Specialisation Mechanica | al Engineering, Foc | us Energy Syster |
| | Compulsory | | | |
| | | program, 7 semester): Specialisation Mechan | ical Engineering, | Focus Mechatroni |
| | Compulsory | gram, 7 semester): Specialisation Mechanical En | aincoring Focus Th | antical Machani |
| | Engineering: Elective Compulsory | grani, 7 semester). Specialisation Mechanical En | igineering, rocus ri | |
| | Digital Mechanical Engineering: Core Qual | ification: Compulsory | | |
| | Electrical Engineering: Core Qualification: | | | |
| | Energy and Environmental Engineering: C | | | |
| | General Engineering Science (English prog | gram, 7 semester): Specialisation Mechanical Eng | ineering: Elective C | ompulsory |
| | Green Technologies: Energy, Water, Clima | te: Specialisation Energy Technology: Elective Co | ompulsory | |
| | Logistics and Mobility: Specialisation Engin | neering Science: Elective Compulsory | | |
| | Logistics and Mobility: Specialisation Traff | c Planning and Systems: Elective Compulsory | | |
| | | uction Management and Processes: Elective Com | pulsory | |
| | Mechanical Engineering: Core Qualification | | | |
| | Mechatronics: Core Qualification: Compute | • | | |
| | | | | |
| | Technomathematics: Specialisation III. En | | | |
| | Engineering and Management - Major in L | jineering Science: Elective Compulsory ogistics and Mobility: Specialisation Traffic Planni Logistics and Mobility: Specialisation Productio | | |

| Course L0293: Electrical Mac | hines and Actuators |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Thorsten Kern, Dennis Kähler |
| Language | DE |
| Cycle | SoSe |
| Content | Electric field: Coulomb's law, flux (field) line, work, potential, capacitor, energy, force, capacitive actuators |
| | Magnetic field: force, flux line, Ampere's law, field at bounderies, flux, magnetic circuit, hysteresis, induction, self-induction, mutual inductance, transformer, electromagnetic actuators |
| | Synchronous machines, construction and layout, equivalent single line diagrams, no-load and short-cuircuit characteristics, vector diagrams, motor and generator operation, stepper motors |
| | 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 (squirrel-cage vs. sliprings), |
| | Drives with variable speed, inverter fed operation, special drives |
| 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 Mac | Course L0294: Electrical Machines and Actuators | |
|------------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Thorsten Kern, Dennis Kähler | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|--|--|---|---|------------------|
| Title | | Тур | Hrs/wk | СР |
| Semiconductor Circuit Design (L076 | 3) | Lecture | 3 | 4 |
| Semiconductor Circuit Design (L086 | (4) | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Matthias Kuhl | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Fundamentals of electrical engineering | | | |
| Knowledge | Basics of physics, especially semiconductor | physics | | |
| | busies of physics, especially semiconductor | physics | | |
| Educational Objectives | After taking part successfully, students have | e reached the following learning results | | |
| Professional Competence Knowledge | Students are able to explain how anaStudents are able to explain the funcStudents know the fundamental digit | tionality of different MOS devices in electronic of log circuits functions and where they are applie tionality of fundamental operational amplifiers a al logic circuits and can discuss their advantage nory circuits and can explain their functionality for the use of bipolar transistors. | d. and their specificatio es and disadvantage | |
| 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 logic circuits. Students can use MOS devices, operational amplifiers and bipolar transistors for specific applications. | | | tronic circuits. |
| Personal Competence Social Competence | Students are able work efficiently in Students working together in small g | neterogeneous teams. roups can solve problems and answer professio | nal questions. | |
| Autonomy | Students are able to assess their leve | el of knowledge. | | |
| Weyldend in House | Independent Chudu Tines 124 Chudu Tines i | | | |
| Credit points | Independent Study Time 124, Study Time ir | Lecture 56 | | |
| Course achievement | | | | |
| Examination | | | | |
| Examination duration and | | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German prog | ram, 7 semester): Specialisation Electrical Engir | eering: Compulsory | |
| Following Curricula | General Engineering Science (German p | rogram, 7 semester): Specialisation Mechan | ical Engineering, F | ocus Mechatror |
| | Compulsory | | | |
| | Data Science: Core Qualification: Elective C | ompulsory | | |
| | Electrical Engineering: Core Qualification: C | ompulsory | | |
| | Engineering Science: Specialisation Electric | al Engineering: Compulsory | | |
| | Engineering Science: Specialisation Mechat | | | |
| | | am, 7 semester): Specialisation Electrical Engine | | |
| | | ogram, 7 semester): Specialisation Mechani | cal Engineering, F | ocus Mechatron |
| | Compulsory | | | |
| | 5 5 7 5 7 5 | am, 7 semester): Specialisation Mechatronics: C | 1 | |
| | | ecialisation II. Mathematics & Engineering Scier | ice: Elective Compul | sory |
| | Mechanical Engineering: Specialisation Mec Mechatronics: Core Qualification: Compulso | | | |
| | meenacionics, core quanneacion, compuiso | ' y | | |

| | br Circuit Design |
|------------|---|
| Тур | Lecture |
| Hrs/wk | |
| СР | |
| | Independent Study Time 78, Study Time in Lecture 42 |
| | Prof. Matthias Kuhl |
| Language | |
| Cycle | , sose |
| | Repetition Semiconductorphysics and Diodes |
| | Functionality and characteristic curve of bipolar transistors |
| | Basic circuits with bipolar transistors |
| | Functionality and characteristic curve of MOS transistors |
| | Basic circuits with MOS transistors for amplifiers |
| | Operational amplifiers and their applications |
| | Typical applications for analog and digital circuits Deslications for analog and digital circuits |
| | Realization of logical functions Basic circuits with MOS transistors for combinational logic |
| | Memory circuits |
| | Basic circuits with MOS transistors for sequential logic |
| | Basic concepts of analog-to-digital and digital-to-analog-converters |
| | |
| Literature | U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 |
| | R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 0471700555 |
| | 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: Semiconducto | or Circuit Design |
|----------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| CP | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Matthias Kuhl, Weitere Mitarbeiter |
| Language | DE |
| Cycle | SoSe |
| Content | Basic circuits and characteristic curves of bipolar transistors Basic circuits and characteristic curves of MOS transistors for amplifiers Realization and dimensioning of operational amplifiers Realization of logic functions Basic circuits with MOS transistors for combinational and sequential logic Memory circuits Circuits for analog-to-digital and digital-to-analog converters Design of exemplary circuits |
| Literature | U. Tietze und Ch. Schenk, E. Gamm, Halbleiterschaltungstechnik, Springer Verlag, 14. Auflage, 2012, ISBN 3540428496 R. J. Baker, CMOS - Circuit Design, Layout and Simulation, J. Wiley & Sons Inc., 3. Auflage, 2011, ISBN: 0471700555 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: Math | ematics IV | | | |
|---------------------------------------|---|--|--------------------|---------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Differential Equations 2 (Partial Dif | erential Equations) (11043) | Lecture | 2 | 1 |
| Differential Equations 2 (Partial Dif | - | Recitation Section (small) | 1 | 1 |
| Differential Equations 2 (Partial Dif | - | 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 |
| | Dref Anusch Toron | | _ | _ |
| Module Responsible | | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mathematics 1 - III | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reache | d the following learning results | | |
| Professional Competence | 51 5. | 5 5 | | |
| - | | | | |
| Knowledge | Students can name the basic concepts in Mat | thematics IV. They are able to explain the | n using appropri | ate examples. |
| | Students can discuss logical connections bet | | | |
| | the help of examples. | | | |
| | | e them | | |
| | They know proof strategies and can reproduce | .e metti. | | |
| | | | | |
| | | | | |
| Skills | - · · · · · · · · · · · · | | | |
| | Students can model problems in Mathematic | | ed in this course | e. Moreover, they |
| | capable of solving them by applying establish | ned methods. | | |
| | Students are able to discover and verify furth | er logical connections between the conce | pts studied in the | e course. |
| | For a given problem, the students can deve | elop and execute a suitable approach, a | nd are able to c | ritically evaluate |
| | 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 cond | cepts according to the needs of their coop | erating partners | . Moreover, they o |
| | design examples to check and deepen the un | derstanding of their peers. | | |
| | | | | |
| | | | | |
| Autonomv | | | | |
| Autonomy | Students are capable of checking their unde | rstanding of complex concepts on their o | wn. They can sp | ecify open question |
| | precisely and know where to get help in solvi | ng them. | | |
| | Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on har | | | |
| | problems. | | g | |
| | problems. | | | |
| | | | | |
| | | | | |
| Workload in Hours | Independent Study Time 68, Study Time in Lecture | 112 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 60 min (Complex Functions) + 60 min (Differential E | Equations 2) | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 s | emester): Specialisation Electrical Enginee | ering: Compulsor | У |
| Following Curricula | General Engineering Science (German program, | 7 semester): Specialisation Mechanica | l Engineering, | Focus Mechatron |
| | Compulsory | | | |
| | General Engineering Science (German program, 7 s | emester): Specialisation Naval Architectur | e: Compulsory | |
| | General Engineering Science (German program, 7 s | • | | neoretical Mechani |
| | Engineering: Elective Compulsory | Encoder and a second second meeting and a second seco | | |
| | | thematica, Elective Computer and | | |
| | Computer Science: Specialisation Computational Ma | | | |
| | Electrical Engineering: Core Qualification: Compulso | | | |
| | General Engineering Science (English program, 7 se | mester): Specialisation Electrical Enginee | ring: Compulsory | , |
| | General Engineering Science (English program, | 7 semester): Specialisation Mechanica | l Engineering, | Focus Mechatron |
| | Compulsory | | | |
| | General Engineering Science (English program, 7 se | emester): Specialisation Mechanical Engin | eering, Focus Th | neoretical Mechani |
| | | encestery, opecialisation meenanical Engli | icening, rocus II | .corecteur meeriali |
| | Engineering: Compulsory | | | |
| | Computational Science and Engineering: Specialisat | | : Elective Compu | ulsory |
| | Mechanical Engineering: Specialisation Mechatronic | s: Compulsory | | |
| | Mechanical Engineering: Specialisation Theoretical I | Mechanical Engineering: Elective Compuls | ory | |
| | Machatronica, Cara Qualification, Compulson, | | | |
| | Mechatronics: Core Qualification: Compulsory | | | |
| | | | | |
| | Naval Architecture: Core Qualification: Compulsory Theoretical Mechanical Engineering: Technical Com | nlementary Course Core Studios: Elective | Compulsory | |

| Course L1043: Differential Ec | quations 2 (Partial Differential Equations) | | |
|-------------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | | | |
| Workload in Hours | ndependent Study Time 2, Study Time in Lecture 28 | | |
| Lecturer | ozenten des Fachbereiches Mathematik der UHH | | |
| Language | Ε | | |
| Cycle | SoSe | | |
| Content | Main features of the theory and numerical treatment of partial differential equations | | |
| Literature | 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 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 |
| CP | 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 Fund | tions | |
|----------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| CP | 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 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 |
| CP | 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 |

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.

| | nced Mechanical Engine | aning besign | | | |
|--|---|--|--|---|---|
| Courses | | | | | |
| Title | | | Тур | Hrs/wk | СР |
| Advanced Mechanical Engineering | | | Lecture | 2 | 2 |
| Advanced Mechanical Engineering Advanced Mechanical Engineering | | | Recitation Section (large) | 2 | 1 2 |
| Advanced Mechanical Engineering | = | | Lecture Recitation Section (large) | 2 | 1 |
| Module Responsible | | | Recitation Dection (large) | - | - |
| Admission Requirements | | | | | |
| Recommended Previous | | | | | |
| Knowledge | Fundamentals of Mechanica | Engineering Design | | | |
| - | Mechanics | | | | |
| | Fundamentals of Materials S | cience | | | |
| | Production Engineering | | | | |
| Educational Objectives | After taking part successfully, stud | ents have reached the follow | ving learning results | | |
| Professional Competence | | | | | |
| Knowledge | After passing the module, students | are able to: | | | |
| | explain complex working pri | nciples and functions of may | chine elements and of basic ele | ments of fluidics | |
| | explain complex working pri explain requirements, select | | | | |
| | indicate the background of c | | | | ine elements, |
| | | , , , , , , , , , , , , , , , , , , , | | | |
| Skills | After passing the module, students | are able to: | | | |
| | accomplish dimensioning ca | Iculations of covered machir | ne elements, | | |
| | transfer knowledge learned | in the module to new require | ements and tasks (problem sol | ving skills), | |
| | recognize the content of tec | hnical drawings and schema | itic sketches, | | |
| | evaluate complex designs, t | echnically. | | | |
| Personal Competence | | | | | |
| Social Competence | | | | | |
| Social competence | Students are able to discuss | technical information in the | e lecture supported by activatir | ng methods. | |
| Autonomy | | | | | |
| Autonomy | Students are able to indepen | ndently deepen their acquire | ed knowledge in exercises. | | |
| | Students are able to acquir | e additional knowledge and | to recapitulate poorly unders | tood content e.g | . by using the vid |
| | recordings of the lectures. | | | | |
| Workload in Hours | Independent Study Time 68, Study | Time in Lecture 112 | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and | | | | | |
| | 120 | | | | |
| scale | | nan program 7 semester): S | | | |
| scale Assignment for the | General Engineering Science (Gern | | pecialisation Mechanical Engir | eering: Compulso | ory |
| Assignment for the | General Engineering Science (Gern General Engineering Science (Ge | | | | |
| Assignment for the | | | | | |
| Assignment for the | General Engineering Science (Ge | erman program, 7 semest | er): Specialisation Mechanica | l Engineering, F | ocus Biomechanio |
| Assignment for the | General Engineering Science (Ge Compulsory | erman program, 7 semest | er): Specialisation Mechanica | l Engineering, F | ocus Biomechanio |
| Assignment for the | General Engineering Science (Ge Compulsory General Engineering Science (Ge | erman program, 7 semest rman program, 7 semester | er): Specialisation Mechanica r): Specialisation Mechanical | l Engineering, F Engineering, Foc | ocus Biomechanio us Energy System |
| Assignment for the | General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory | erman program, 7 semest rman program, 7 semester rman program, 7 semester | er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical | l Engineering, F Engineering, Foc Engineering, Foc | ocus Biomechanio us Energy System us Aircraft Syster |
| Assignment for the | General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (G | erman program, 7 semest rman program, 7 semester rman program, 7 semester erman program, 7 semes | er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical | l Engineering, F Engineering, Foc Engineering, Foc | ocus Biomechanio us Energy System us Aircraft Syster |
| Assignment for the | General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (G Engineering Sciences: Compulsory | erman program, 7 semest rman program, 7 semester rman program, 7 semester erman program, 7 semest | er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical ster): Specialisation Mechanic | I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, | ocus Biomechanio us Energy System us Aircraft Syster Focus Materials |
| Assignment for the | General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (G Engineering Sciences: Compulsory General Engineering Science (Ge | erman program, 7 semest rman program, 7 semester rman program, 7 semester erman program, 7 semest | er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical ster): Specialisation Mechanic | I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, | ocus Biomechanio us Energy System us Aircraft Syster Focus Materials |
| Assignment for the | General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Engineering Sciences: Compulsory General Engineering Science (Ge Compulsory | erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest | er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical ster): Specialisation Mechanica ser): Specialisation Mechanica | I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, I al Engineering, I | ocus Biomechanic us Energy System us Aircraft Syster Focus Materials Focus Mechatronic |
| Assignment for the | General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Engineering Sciences: Compulsory General Engineering Science (Gen Compulsory General Engineering Science (Gen | erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest | er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical ster): Specialisation Mechanica ser): Specialisation Mechanica | I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, I al Engineering, I | ocus Biomechanic us Energy System us Aircraft Syster Focus Materials Focus Mechatronic |
| Assignment for the | General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ger Compulsory General Engineering Science (Ger and Production: Compulsory | erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest man program, 7 semester): | er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical ster): Specialisation Mechanica ser): Specialisation Mechanica Specialisation Mechanical Eng | I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, al Engineering, f ineering, Focus P | ocus Biomechanic us Energy System us Aircraft System Focus Materials Focus Mechatronic roduct Developme |
| Assignment for the | General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Engineering Sciences: Compulsory General Engineering Science (Gen Compulsory General Engineering Science (Gen | erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest man program, 7 semester): | er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical ster): Specialisation Mechanica ser): Specialisation Mechanica Specialisation Mechanical Eng | I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, al Engineering, f ineering, Focus P | ocus Biomechanic us Energy System us Aircraft System Focus Materials Focus Mechatronic roduct Developme |
| Assignment for the | General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger | erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest man program, 7 semester): nan program, 7 semester): 5 | er): Specialisation Mechanica (): Specialisation Mechanical (): Specialisation Mechanical (ter): Specialisation Mechanica (ter): Specialisation Mechanical Engli Specialisation Mechanical Engli | I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, al Engineering, f ineering, Focus P | ocus Biomechanic us Energy System us Aircraft System Focus Materials Focus Mechatronic roduct Developme |
| Assignment for the | General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger Engineering: Compulsory General Engineering Science (Ger Engineering: Compulsory | erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest man program, 7 semester): man program, 7 semester): S ementary Course Core Studie | er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical ster): Specialisation Mechanica rer): Specialisation Mechanica Specialisation Mechanical Engines se: Elective Compulsory | I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, al Engineering, f ineering, Focus P | ocus Biomechanic us Energy System us Aircraft System Focus Materials Focus Mechatronic roduct Developme |
| Assignment for the | General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger Engineering: Compulsory General Engineering Science (Ger Engineering: Compulsory Energy Systems: Technical Comple | erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest man program, 7 semester): man program, 7 semester): sementary Course Core Studie n Mechanical Engineering: Co | er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical ster): Specialisation Mechanica rer): Specialisation Mechanica Specialisation Mechanical Engines Specialisation Mechanical Engineses Specialisation Mechanic | I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, al Engineering, f ineering, Focus P neering, Focus Th | ocus Biomechanic us Energy System us Aircraft System Focus Materials Focus Mechatronic roduct Developme eoretical Mechanic |
| Assignment for the | General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger Engineering: Compulsory General Engineering Science (Ger Engineering: Compulsory Energy Systems: Technical Comple Engineering Science: Specialisation | erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest man program, 7 semester): man program, 7 semester): S ementary Course Core Studie n Mechanical Engineering: Co ish program, 7 semester): Sp | er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical ster): Specialisation Mechanica rer): Specialisation Mechanical Specialisation Mechanical Engineses: Elective Compulsory populsory pecialisation Mechanical Engine | al Engineering, F Engineering, Foc Engineering, Foc cal Engineering, F al Engineering, F ineering, Focus P neering, Focus Th eering: Compulso | iocus Biomechanic us Energy System us Aircraft System Focus Materials Focus Mechatronic roduct Developme reoretical Mechanic |
| Assignment for the | General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Engineering Sciences: Compulsory General Engineering Science (Ger Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger Engineering: Compulsory General Engineering Science (Ger Engineering: Compulsory Energy Systems: Technical Comple Engineering Science: Specialisatior General Engineering Science (Engli | erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest man program, 7 semester): man program, 7 semester): S ementary Course Core Studie n Mechanical Engineering: Co ish program, 7 semester): Sp | er): Specialisation Mechanica r): Specialisation Mechanical r): Specialisation Mechanical ster): Specialisation Mechanica rer): Specialisation Mechanical Specialisation Mechanical Engineses: Elective Compulsory populsory pecialisation Mechanical Engine | al Engineering, F Engineering, Foc Engineering, Foc cal Engineering, F al Engineering, F ineering, Focus P neering, Focus Th eering: Compulso | iocus Biomechanic us Energy System us Aircraft System Focus Materials Focus Mechatronic roduct Developme reoretical Mechanic |
| Assignment for the | General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Engineering Sciences: Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger Engineering: Compulsory General Engineering Science (Ger Engineering: Compulsory Energy Systems: Technical Comple Engineering Science: Specialisatior General Engineering Science (Engli General Engineering Science (Engli General Engineering Science (Engli | erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest man program, 7 semester): man program, 7 semester): sementary Course Core Studie n Mechanical Engineering: Co ish program, 7 semester): Sp nglish program, 7 semester | er): Specialisation Mechanica (): Specialisation Mechanical (): Specialisation Mechanical (): Specialisation Mechanical (): Specialisation Mechanical Englisition Mechanical Englises (): Specialisation Mechanical Englises (): Elective Compulsory (): Specialisation Mechanical Englises (): Specialisation Mechanical Engl | I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, al Engineering, I ineering, Focus P neering, Focus Th eering: Compulso I Engineering, F | ocus Biomechanic us Energy System us Aircraft System Focus Materials Focus Mechatronic roduct Developme reoretical Mechanic ry ocus Biomechanic |
| Assignment for the | General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Engineering Sciences: Compulsory General Engineering Science (Ger Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger Engineering: Compulsory Energy Systems: Technical Comple Engineering Science: Specialisatior General Engineering Science (Engli General Engineering Science (Engli | erman program, 7 semeste rman program, 7 semester rman program, 7 semester erman program, 7 semest erman program, 7 semest man program, 7 semester): man program, 7 semester): sementary Course Core Studie n Mechanical Engineering: Co ish program, 7 semester): Sp nglish program, 7 semester | er): Specialisation Mechanica (): Specialisation Mechanical (): Specialisation Mechanical (): Specialisation Mechanical (): Specialisation Mechanical Englisition Mechanical Englises (): Specialisation Mechanical Englises (): Elective Compulsory (): Specialisation Mechanical Englises (): Specialisation Mechanical Engl | I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, al Engineering, I ineering, Focus P neering, Focus Th eering: Compulso I Engineering, F | ocus Biomechanic us Energy System us Aircraft System Focus Materials Focus Mechatronic roduct Developme reoretical Mechanic ry ocus Biomechanic |
| Assignment for the | General Engineering Science (Ge Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ge Engineering: Compulsory General Engineering Science (Ge Compulsory General Engineering Science (Ger and Production: Compulsory General Engineering Science (Ger Engineering: Compulsory General Engineering Science (Ger Engineering: Compulsory General Engineering Science (Ger Engineering: Compulsory Energy Systems: Technical Comple Engineering Science: Specialisatior General Engineering Science (Engli General Engineering Science (Engli | erman program, 7 semester rman program, 7 semester rman program, 7 semester erman program, 7 semester erman program, 7 semest man program, 7 semester): man program, 7 semester): mentary Course Core Studie n Mechanical Engineering: Co ish program, 7 semester): Sp nglish program, 7 semester glish program, 7 semester | er): Specialisation Mechanica (): Specialisation Mechanical (): Specialisation Mechanical (): Specialisation Mechanical (): Specialisation Mechanical Englise Specialisation Mechanical Englise (): Specialisation Mechanical Englise (): Specialisation Mechanical Englise (): Specialisation Mechanical Englise (): Specialisation Mechanical Inglise (): Specialisat | I Engineering, F Engineering, Foc Engineering, Foc cal Engineering, Foc al Engineering, I ineering, Focus P neering, Focus Th eering: Compulso I Engineering, Foc | iocus Biomechanie us Energy System us Aircraft System Focus Materials Focus Mechatronie roduct Developme roduct Developme roretical Mechanie ry ocus Biomechanie us Energy System |

| 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 |
| Mechanical Engineering: Core Qualification: Compulsory |
| Naval Architecture: Core Qualification: Compulsory |

| Course L0264: Advanced Me | chanical Engineering Design II | |
|---------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| CP | 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 | |
| | • Elements of hubbles | |
| | Exercise | |
| | Calculation methods of the following machine elements: | |
| | Linear rolling bearings | |
| | • Axes & shafts | |
| | Clutches & brakes | |
| | • Belt & chain drives | |
| | Gear drives Friendle and a | |
| | 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. | |
| | Sowie weitere Bücher zu speziellen Themen | |

| Course L0265: Advanced Mechanical Engineering Design II | | |
|---|--|--|
| Тур | ation Section (large) | |
| Hrs/wk | 2 | |
| CP | 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 | |

| avT | Lecture | |
|-------------------|--|--|
| Hrs/wk | | |
| CP | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| | Prof. Dieter Krause, Prof. Otto von Estorff | |
| Language | | |
| | WiSe | |
| - | 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 | |
| | 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, aktu | |
| | Maschineheinente - Gestaltung, Berechnung, Anwendung, Haberhauer, H., Bodenstein, F., Springer-verlag, aktu 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 |
| CP | 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 | |
|---|--|
| itle dvanced Mechanical Design Proje | Typ Hrs/wk CP ect (L0266) Project-/problem-based Learning 4 6 |
| Module Responsible | |
| Admission Requirements | |
| Recommended Previous | |
| Knowledge | Mechanical Engineering: Design |
| j- | Advanced Mechanical Engineering Design |
| Educational Objectives | After taking part successfully, students have reached the following learning results |
| Professional Competence | |
| Knowledge | After passing the module, students are able to: |
| | |
| | express the procedure for systematically handling of |
| | complex design tasks , describe working principles, their use and combination possibilities, |
| | explain guidelines for designing for function and manufacturing, |
| | explain galaxies of designing of function and manufacturing, explain advanced use-oriented knowledge of machine elements. |
| | |
| Skills | After passing the module, students are able to: |
| | analyze complex tasks and develop principle solutions using sketches, |
| | convert principle solutions into a detailed design, |
| | use methods to design and solve engineering design tasks systematically and solution-oriented, |
| | create a technical documentation including all necessary technical drawings to understand the functions of the system, |
| | document calculations of selected machine elements clearly and in detail. |
| | |
| Personal Competence | |
| Social Competence | After passing the module, students are able to: |
| | present and discuss solutions and technical drawings within groups, |
| | reflect the own results in the work groups of the course |
| Autonomy | After passing the module, students are able to: |
| Autonomy | |
| | • independently solve complex design projects, while motivating themselves, acquiring necessary knowledge and select |
| | appropriate methods, |
| | to independently solve problems. |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Credit points | |
| Course achievement | Compulsory Bonus Form Description |
| | Yes None Attestation |
| Examination | Written exam |
| Examination duration and | 180 |
| scale | |
| - | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste |
| Following Curricula | Engineering: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm |
| | and Production: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste |
| | Engineering: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm |
| | |
| | and Production: Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory |

| Course L0266: Advanced Med | chanical Design Project |
|----------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| CP | 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 | | Turn | Hrs/wk | СР |
| Fundamentals of Machine Tools (L0 | 689) | Typ Lecture | 2 | 2 |
| Fundamentals of Machine Tools (L1 | | Recitation Section (large) | 1 | 1 |
| Forming and Cutting Technology (L | 0613) | Lecture | 2 | 2 |
| Forming and Cutting Technology (L | 0614) | Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof. Wolfgang Hintze | | | |
| Admission Requirements | None | | | |
| | without major course assessment | | | |
| Knowledge | internship recommended | | | |
| | Previous knowledge in mathematics, mechanics a | nd electrical engineering | | |
| Educational Objectives | After taking part successfully, students have reach | ed the following learning results | | |
| Professional Competence | | | | |
| - | Students are able to | | | |
| | - evaluin the basics of this formation | | | |
| | explain the basics of chip formation and me explain methods and parameters for design | | recorder and to | |
| | explain methods and parameters for design explain technical concepts of machine tool | | | |
| | explain types, constructions and functions of | | | |
| | explain equipment components. | | | |
| Skills | Students are able to | | | |
| | | | in a ta shaita a ta | |
| | select tool geometry, cutting materials, pro requirements. | ocess parameters and appropriate measur | ing technique in | accordance with tr |
| | estimate occurring forces and temperatures | during chip formation | | |
| | select appropriate machine tools for machine | | d milling. | |
| | assess the quality of a machine tools and to | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to | | | |
| | • develop solutions in a production environme | ent with qualified personnel at technical lev | el and represent | decisions. |
| Autonomy | Students are able to | | | |
| | interpret independently cutting processes. | | | |
| | create independently NC programs. | | | |
| | select independently machine tools by refer | ence to appropriate requirements. | | |
| | assess own strengths and weaknesses in get | | | |
| | assess their learning progress and define gate | aps to be improved. | | |
| | assess possible consequences of their actio | ns. | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture | e 84 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| | 180 min | | | |
| scale | | | | |
| - | General Engineering Science (German program, 7 | semester): Specialisation Mechanical Eng | ineering, Focus F | roduct Developme |
| Following Curricula | and Production: Compulsory | comotor), Chosialization Machaniat | nooring Frances | Iroduct Devictore |
| | General Engineering Science (English program, 7 | semester): specialisation Mechanical Eng | neering, Focus P | TOQUET Development |
| | and Production: Compulsory | | | |
| | Mechanical Engineering: Specialisation Product De | velopment and Production: Compulson | | |

| Course L0689: Fundamentals | of Mashina Taala |
|----------------------------|--|
| | |
| Тур Hrs/wk | 2 |
| CP | |
| | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Thorsten Schüppstuhl |
| Language | DE |
| Cycle | |
| Content | Terminology and trends in machine tool building |
| | CNC controls |
| | NC programming and NC programming systems |
| | Types, construction and function of CNC machines |
| | Multi-machinesystems |
| | Equipmentcomponents for machine tools |
| | Assessment of machine tools |
| Literature | 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 |
| | 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 | ourse L1992: Fundamentals of Machine Tools | |
|----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | 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 | |

| Course L0613: Forming and Cutting Technology | |
|--|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 | ourse L0614: Forming and Cutting Technology | |
|---------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | 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 | |

| | iction Engineering | | | |
|-----------------------------------|---|--|--------------------|-------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Production Engineering I (L0608) | | Lecture | 2 | 2 |
| Production Engineering I (L0612) | | Recitation Section (large) | 1 | 1 |
| Production Engineering II (L0610) | | Lecture | 2 | 2 |
| Production Engineering II (L0611) | | Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof. Wolfgang Hintze | | | |
| Admission Requirements | None | | | |
| Recommended Previous | no course assessments required | | | |
| Knowledge | | | | |
| laiomeage | internship recommended | | | |
| | | | | |
| - | After taking part successfully, students have | e reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to | | | |
| | name basic criteria for the selection o | of manufacturing processos | | |
| | | | | |
| | name the main groups of Manufacturi | | | |
| | name the application areas of different | | | |
| | | sadvantages of the different manufacturing proce | | |
| | describe elements, geometric propert | ties and kinematic variables and requirements for | r tools, workpiece | and process. |
| | explain the essential models of manufactorial | facturing technology. | | |
| | | | | |
| | | | | |
| Skills | Students are able to | | | |
| | | | | |
| | select manufacturing processes in acc | cordance with the requirements. | | |
| | design manufacturing processes for signature | imple tasks to meet the required tolerances of th | ne component to b | pe produced. |
| | assess components in terms of their p | production-oriented construction. | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| | Students are able to | | | |
| Social Competence | | | | |
| | develop solutions in a production envi | ironment with qualified personnel at technical lev | vel and represent | decisions. |
| | | | | |
| | | | | |
| Autonomic | Students are able to | | | |
| Autonomy | | | | |
| | interpret independently the manufact | uring process. | | |
| | assess own strengths and weaknesses | s in general. | | |
| | assess their learning progress and de | - | | |
| | assess possible consequences of their | | | |
| | • assess possible consequences of them | actions. | | |
| | | | | |
| | | | | |
| Workload in Hours | Independent Study Time 96, Study Time in L | Lecture 84 | | |
| Credit points | 6 | | | |
| Course achievement | | | | |
| | | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German progr | ram, 7 semester): Specialisation Mechanical Eng | gineering, Focus P | Product Developn |
| Following Curricula | and Production: Compulsory | | | |
| | General Engineering Science (German progr | ram, 7 semester): Specialisation Mechanical Engi | ineering, Focus Th | neoretical Mechar |
| | Engineering: Elective Compulsory | | | |
| | Digital Mechanical Engineering: Core Qualific | cation: Compulsory | | |
| | Engineering Science: Specialisation Mechani | | | |
| | | | ooring. Commut- | |
| | | am, 7 semester): Specialisation Mechanical Engin | | |
| | | am, 7 semester): Specialisation Mechanical Engi | neering, Focus Th | neoretical Mechar |
| | Engineering: Elective Compulsory | | | |
| | Green Technologies: Energy, Water, Climate | e: Specialisation Energy Technology: Elective Com | npulsory | |
| | Logistics and Mobility: Specialisation Product | tion Management and Processes: Compulsory | | |
| | 1 | | | |
| | Logistics and Mobility: Specialisation Engine | ering Science: Elective Compulsory | | |
| | | | | |
| | Mechanical Engineering: Core Qualification: | Compulsory | | |
| | | Compulsory | | |

| Course L0608: Production En | igineering I |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 En | ourse 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 | |
| CP | 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 En | ourse L0611: Production Engineering II | |
|-----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | 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 | | | | |
|-------------------------------------|--|---|---|---|
| Title | | Тур | Hrs/wk | СР |
| Computer Engineering (L0321) | | Lecture | 3 | 4 |
| Computer Engineering (L0324) | | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Heiko Falk | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge in electrical engineering | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have re | ached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | This module deals with the foundations of the programming down to gates. The module inclusion Introduction | | ers the layers fron | n the assembly-le |
| | Sequential logic: Flip-flops, automata, sy Technological foundations Computer arithmetic: Integer addition, si Basics of computer architecture: Program Memories: Memory hierarchies, SRAM, D | ubtraction, multiplication and division nming models, MIPS single-cycle architecture | e, pipelining | |
| Skills | The students perceive computer systems from composition of computer systems. The student collection of few and simple components. The today's computing systems - from gates and ci After successful completion of the module, th system and the software executed on it. In par on the hardware-centric abstraction layers fror the impact that these low abstraction levels ha | s can analyze, how highly specific and indivi y are able to distinguish between and to ex rcuits up to complete processors. e students are able to judge the interdepen ticular, they shall understand the consequen n the assembly language down to gates. Thi | dual computers can plain the different indencies between inces that the exect s way, they will be | n be built based o abstraction layers a physical compu- ution of software l enabled to evalu |
| Borconal Competence | | | | |
| Personal Competence | | no or in a group and to present the results a | cordingly | |
| Social Competence | Students are able to solve similar problems alo | ne or in a group and to present the results a | cordingly. | |
| Autonomy | Students are able to acquire new knowledge fro | om specific literature and to associate this kr | nowledge with othe | r classes. |
| Werkleed in Heure | Independent Study Time 124, Study Time in Le | atura FC | | |
| | Independent Study Time 124, Study Time in Le | cture 56 | | |
| Credit points Course achievement | | Description | | |
| course acmevement | Yes 10 % Excercises | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 minutes, contents of course and labs | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program | , 7 semester): Specialisation Computer Scier | nce: Compulsory | |
| Following Curricula | General Engineering Science (German program | , 7 semester): Specialisation Civil Engineerin | g: Compulsory | |
| | General Engineering Science (German program | , 7 semester): Specialisation Process Engine | ering: Compulsory | |
| | General Engineering Science (German progr | ram, 7 semester): Specialisation Mechani | cal Engineering, I | Focus Mechatron |
| | Compulsory | | | |
| | General Engineering Science (German progra | am, 7 semester): Specialisation Mechanica | l Engineering, Foc | us Aircraft Syste |
| | Engineering: Compulsory | | | |
| | General Engineering Science (German program | 7 semester): Specialisation Mechanical End | gineering, Focus Th | eoretical Mechan |
| | | ,, | | |
| | Engineering: Compulsory | | | |
| | Engineering: Compulsory General Engineering Science (German prog | | nical Engineering, | |
| | Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory | ram, 7 semester): Specialisation Mechar | | Focus Materials |
| | Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German program | ram, 7 semester): Specialisation Mechar | | Focus Materials |
| | Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory | ram, 7 semester): Specialisation Mechar n, 7 semester): Specialisation Mechanical Er | ngineering, Focus P | Focus Materials Product Developm |
| | Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory | ram, 7 semester): Specialisation Mechar n, 7 semester): Specialisation Mechanical Er | ngineering, Focus P | Focus Materials Product Developm |
| | Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German program | rram, 7 semester): Specialisation Mechar n, 7 semester): Specialisation Mechanical Er am, 7 semester): Specialisation Mechanica | ngineering, Focus P I Engineering, Foc | Focus Materials Product Developm us Energy System |
| | Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German progra Compulsory | rram, 7 semester): Specialisation Mechar n, 7 semester): Specialisation Mechanical Er am, 7 semester): Specialisation Mechanica | ngineering, Focus P I Engineering, Foc | Focus Materials Product Developm us Energy System |
| | Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program) | ram, 7 semester): Specialisation Mechar n, 7 semester): Specialisation Mechanical Er am, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architect , 7 semester): Specialisation Biomedical Eng , 7 semester): Specialisation Bioprocess Eng , 7 semester): Specialisation Electrical Engin | ngineering, Focus P I Engineering, Foc cal Engineering, F ure: Compulsory ineering: Compulsory ineering: Compulsory | Focus Materials Product Developm us Energy System Focus Biomechan Pry Pry |
| | Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program General Engineering Science (German program | ram, 7 semester): Specialisation Mechar n, 7 semester): Specialisation Mechanical Er am, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architect , 7 semester): Specialisation Biomedical Eng , 7 semester): Specialisation Bioprocess Eng , 7 semester): Specialisation Electrical Engin , 7 semester): Specialisation Green Technolo | ngineering, Focus P I Engineering, Foc cal Engineering, F ure: Compulsory ineering: Compulsory ineering: Compulsory | Focus Materials Product Developm us Energy System Focus Biomechan Pry Pry |
| | Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program General Engineering Science (German program | ram, 7 semester): Specialisation Mechar n, 7 semester): Specialisation Mechanical Er am, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanic , 7 semester): Specialisation Naval Architect , 7 semester): Specialisation Biomedical Eng , 7 semester): Specialisation Bioprocess Eng , 7 semester): Specialisation Electrical Engin , 7 semester): Specialisation Green Technolo | ngineering, Focus P I Engineering, Foc cal Engineering, F ure: Compulsory ineering: Compulsory ineering: Compulsory | Focus Materials Product Developm us Energy System Focus Biomechan Pry Y |
| | Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program General Engineering Science (German program Compulsory Computer Science: Core Qualification: Compulse | ram, 7 semester): Specialisation Mechar n, 7 semester): Specialisation Mechanical Er am, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architect , 7 semester): Specialisation Biomedical Eng , 7 semester): Specialisation Bioprocess Eng , 7 semester): Specialisation Electrical Engin , 7 semester): Specialisation Green Technolo ory pulsory | ngineering, Focus P I Engineering, Foc cal Engineering, F ure: Compulsory ineering: Compulsory ineering: Compulsory | Focus Materials Product Developm us Energy System Focus Biomechan Pry Y |
| | Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program General Engineering Science (German program Compulsory Computer Science: Core Qualification: Compuls | ram, 7 semester): Specialisation Mechan n, 7 semester): Specialisation Mechanical Er am, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architect , 7 semester): Specialisation Biomedical Eng , 7 semester): Specialisation Bioprocess Eng , 7 semester): Specialisation Electrical Engin , 7 semester): Specialisation Green Technolo ory pulsory | ngineering, Focus P I Engineering, Foc cal Engineering, F ure: Compulsory ineering: Compulsory ineering: Compulsory ogies, Focus Renew | Focus Materials Product Developm us Energy Syste Focus Biomechan Pry Y |
| | Engineering: Compulsory General Engineering Science (German prog Engineering Sciences: Compulsory General Engineering Science (German program and Production: Compulsory General Engineering Science (German progra Compulsory General Engineering Science (German program General Engineering | ram, 7 semester): Specialisation Mechan n, 7 semester): Specialisation Mechanical Er am, 7 semester): Specialisation Mechanica ram, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architect , 7 semester): Specialisation Biomedical Eng , 7 semester): Specialisation Bioprocess Eng , 7 semester): Specialisation Electrical Engin , 7 semester): Specialisation Green Technolo ory pulsory oulsory 7 semester): Specialisation Civil Engineering | ngineering, Focus P I Engineering, Foc cal Engineering, Foc ure: Compulsory ineering: Compulsory ineering: Compulsory ogies, Focus Renew g: Compulsory | Focus Materials Product Developm us Energy Syste Focus Biomechan Pry Pry dable Energy: Elec |

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

| Course L0321: Computer Eng | jineering |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Heiko Falk |
| Language | DE/EN |
| 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 Eng | gineering |
|----------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| CP | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Heiko Falk |
| Language | DE/EN |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Module M0599: Integ | rated Product I | Development and | d Lightweigh | t Design | | |
|------------------------------------|-------------------------------------|---------------------------------------|---------------------|--------------------------------------|------------------|---------------------|
| Courses | | | | | | |
| Title | | | | Тур | Hrs/wk | СР |
| CAE-Team Project (L0271) | | | | Project-/problem-based Learning | 2 | 2 |
| Development of Lightweight Design | n Products (L0270) | | | Lecture | 2 | 2 |
| Integrated Product Development I (| (L0269) | | | Lecture | 2 | 2 |
| Module Responsible | Prof. Dieter Krause | | | | | |
| Admission Requirements | None | | | | | |
| | Advanced Knowledge | about engineering desi | gn: | | | |
| Knowledge | Fundamentals of Mec | hanical Engineering Des | ign | | | |
| | Mechanical Engineeri | ng: Design | | | | |
| | Advanced Mechanical | | | | | |
| Educational Objectives | After taking part succ | essfully, students have | reached the followi | ng learning results | | |
| Professional Competence | | | | | | |
| Knowledge | After completing the | module, students are ca | pable of: | | | |
| | explaining the | functional principle of 3 | D-CAD-Systems, PD | M- and FEM-Systems | | |
| | | | | the product development proces | SS | |
| | | | | | | |
| Skills | | | | | | |
| | After completing the | module, students are ab | le to: | | | |
| | | | | | | |
| | | | | | | |
| | evaluate differ | ent CAD- and PDM-Sys | tems with regards | to the desired requirements su | ich as classific | ation schemes and |
| | product structu | ıring | | | | |
| | design an exer | nplary product using CA | D-,PDM- and/or FEN | 1-Systems with shared workload | | |
| | | | | | | |
| | | | | | | |
| Personal Competence | | | | | | |
| Social Competence | After completing the | module, students are ab | le to: | | | |
| | To develop a p | roiect plan and allocate | work appropriate w | ork packages in the framework | of aroup discu | ssions |
| | | results as a team for in | | | <u>5</u> p | |
| | | | | | | |
| Autonomy | Students are capable | of: | | | | |
| | independently | adapt to a CAE-Tool and | l complete a given | practical task with it | | |
| | | · · · · · · · · · · · · · · · · · · · | | | | |
| Workload in Hours | Independent Study Ti | me 96, Study Time in Le | ecture 84 | | | |
| Credit points | | | | | | |
| Course achievement | | Form | Description | ojekt inkl. Vortrag und Ausarbeitu | ing | |
| | Yes 20 % | Subject theoretical practical work | and CAL-reampio | Jekt linki. Volti ag ullu Ausai belu | ing | |
| Examination | Written exam | proceeding | | | | |
| Examination duration and | 1 | | | | | |
| scale | | | | | | |
| Assignment for the | | Science (German proc | Iram, 7 semester) | : Specialisation Mechanical End | ineering, Focu | is Aircraft Systems |
| Following Curricula | | sory | | | | |
| _ | General Engineering | Science (German progra | am, 7 semester): S | pecialisation Mechanical Engine | ering, Focus Pr | oduct Development |
| | and Production: Comp | oulsory | | | | |
| | Engineering Science: | Specialisation Mechanic | al Engineering: Ele | ctive Compulsory | | |
| | General Engineering | Science (English prog | ram, 7 semester): | Specialisation Mechanical Eng | ineering, Focu | is Aircraft Systems |
| | Engineering: Compuls | sory | | | | |
| | General Engineering | Science (English progra | m, 7 semester): S | pecialisation Mechanical Enginee | ering, Focus Pr | oduct Development |
| | and Production: Comp | oulsory | | | | |
| | | | | ecialisation Mechanical Engineeri | ng: Elective Co | mpulsory |
| | - | | | d Production: Compulsory | | |
| | - | ng: Specialisation Aircra | | | | |
| | Product Development | , Materials and Producti | on: Technical Comp | plementary Course Core Studies: | Elective Comp | ulsory |

| Course L0271: CAE-Team Pro | ject |
|----------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 2 |
| CP | 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 |
| CP | 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 Pr | oduct Development l |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 M0865: Funda | mentals of Production and | l Quality Management | | |
|-------------------------------------|--|---|-------------------------|---------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Production Process Organization (LC | 0925) | Lecture | 2 | 3 |
| Quality Management (L0926) | | Lecture | 2 | 3 |
| Module Responsible | Prof. Hermann Lödding | | | |
| Admission Requirements | | | | |
| Recommended Previous | None | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students | have reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to explain the conten | ts of the lecture of the module. | | |
| Skills | Students are able to apply the methods | and models in the module to industrial problem | S. | |
| Personal Competence | | | | |
| Social Competence | - | | | |
| Autonomy | - | | | |
| Workload in Hours | Independent Study Time 124, Study Tir | ne in Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 180 Minuten | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German | n program, 7 semester): Specialisation Mecha | nical Engineering, Foc | us Aircraft Systems |
| Following Curricula | Engineering: Compulsory | | | |
| | General Engineering Science (German | program, 7 semester): Specialisation Mechanica | al Engineering, Focus P | Product Development |
| | and Production: Compulsory | | | |
| | Engineering Science: Core Qualification | | | |
| | | rogram, 7 semester): Specialisation Mechanical B | | ompulsory |
| | | rogram, 7 semester): Core Qualification: Compul | - | |
| | | oduction Management and Processes: Compulso | ry | |
| | | gineering Science: Elective Compulsory | | |
| | Mechanical Engineering: Core Qualificat | | | |
| | Engineering and Management - Major in | n Logistics and Mobility: Specialisation Production | n Management and Pro | cesses: Compulsory |

| Course L0925: Production Pr | ocess Organization | | |
|-----------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | ependent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Hermann Lödding | | |
| Language | | | |
| Cycle | | | |
| Content | (A) Introduction | | |
| | (B) Product planning | | |
| | (C) Process planning | | |
| | (D) Procurement | | |
| | (E) Manufacturing | | |
| | (F) Production planning and control (PPC) | | |
| | (G) Distribution | | |
| | (H) Cooperation | | |
| Literature | Wiendahl, HP.: Betriebsorganisation für Ingenieure | | |
| | Vorlesungsskript | | |

| Course L0926: Quality Manag | gement |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 |

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.

| | nced Mechanical Engin | | | | |
|--|--|---|---|--|--|
| Courses | | | | | |
| Title | | | Тур | Hrs/wk | СР |
| Advanced Mechanical Engineering | | | Lecture | 2 | 2 |
| Advanced Mechanical Engineering | | | Recitation Section (large) | 2 | 1 |
| Advanced Mechanical Engineering Advanced Mechanical Engineering | | | Lecture Recitation Section (large) | 2 | 2 1 |
| | | | Recitation Section (large) | 2 | - |
| Module Responsible | | | | | |
| Admission Requirements | | | | | |
| Recommended Previous | Fundamentals of Mechani | cal Engineering Design | | | |
| Knowledge | Mechanics | | | | |
| | Fundamentals of Materials | s Science | | | |
| | Production Engineering | | | | |
| | | | | | |
| | After taking part successfully, st | udents have reached the fo | llowing learning results | | |
| Professional Competence | | | | | |
| Knowledge | After passing the module, studer | its are able to: | | | |
| | explain complex working | principles and functions of | machine elements and of basic ele | ments of fluidics, | |
| | | | cenarios and practical examples o | | |
| | indicate the background of | of dimensioning calculations | 5. | | |
| | After a second the second s | ata ang abla tu | | | |
| Skills | After passing the module, studer | its are able to: | | | |
| | accomplish dimensioning | calculations of covered ma | chine elements, | | |
| | transfer knowledge learne | ed in the module to new rec | uirements and tasks (problem sol | ving skills), | |
| | recognize the content of t | echnical drawings and sche | ematic sketches, | | |
| | evaluate complex designs | , technically. | | | |
| | | | | | |
| Personal Competence | | | | | |
| Social Competence | Students are able to discu | iss technical information in | the lecture supported by activatin | g methods. | |
| | | | | 5 | |
| Autonomy | | pendently deepen their acq | uired knowledge in exercises. | | |
| | | | and to recapitulate poorly unders | tood content e a | by using the vid |
| | recordings of the lectures | | and to recupitulate poorly anders | cood content e.g | . by using the vie |
| | · · · · · · · · · · · · · · · · · · · | · | | | |
| Workload in Hours | Independent Study Time 68, Stu | dy Time in Lecture 112 | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and | 120 | | | | |
| Examination duration and | | | | | |
| Examination duration and scale | | | | | |
| scale | General Engineering Science (Ge | erman program, 7 semester |): Specialisation Mechanical Engin | eering: Compulso | ory |
| scale Assignment for the | | |): Specialisation Mechanical Engin ester): Specialisation Mechanica | | - |
| scale Assignment for the | | | | | - |
| scale Assignment for the | General Engineering Science (Compulsory | (German program, 7 sem | | l Engineering, F | ocus Biomechani |
| scale Assignment for the | General Engineering Science (Compulsory | (German program, 7 sem | ester): Specialisation Mechanica | l Engineering, F | ocus Biomechani |
| scale Assignment for the | General Engineering Science (Compulsory General Engineering Science (Compulsory | (German program, 7 sem German program, 7 seme | ester): Specialisation Mechanica | l Engineering, F Engineering, Foci | ocus Biomechani us Energy Syster |
| scale Assignment for the | General Engineering Science (Compulsory General Engineering Science (Compulsory | (German program, 7 sem German program, 7 seme | ester): Specialisation Mechanica ster): Specialisation Mechanical I | l Engineering, F Engineering, Foci | ocus Biomechani us Energy Syster |
| scale Assignment for the | General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory | (German program, 7 sem German program, 7 seme German program, 7 seme | ester): Specialisation Mechanica ster): Specialisation Mechanical I | I Engineering, F Engineering, Foct Engineering, Foc | ocus Biomechani us Energy Syster us Aircraft Syste |
| scale Assignment for the | General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory | (German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 ser | ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical | I Engineering, F Engineering, Foct Engineering, Foc | ocus Biomechani us Energy Syster us Aircraft Syste |
| scale Assignment for the | General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science Engineering Sciences: Compulso | (German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 ser ry | ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical | I Engineering, F Engineering, Focu Engineering, Focu al Engineering, | ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials |
| scale Assignment for the | General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science Engineering Sciences: Compulso | (German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 ser ry | ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanic | I Engineering, F Engineering, Focu Engineering, Focu al Engineering, | ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials |
| scale Assignment for the | General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (G | (German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 sen ry (German program, 7 sen | ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanic | I Engineering, F Engineering, Foct Engineering, Foc al Engineering, F I Engineering, F | ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials Focus Mechatroni |
| scale Assignment for the | General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (Gand Production: Compulsory | (German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 ser ry (German program, 7 sem erman program, 7 semeste | ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical mester): Specialisation Mechanica ester): Specialisation Mechanica er): Specialisation Mechanical Eng | I Engineering, F Engineering, Foci Engineering, Foci al Engineering, II Engineering, F ineering, Focus P | ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials Focus Mechatroni roduct Developme |
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| scale Assignment for the | General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (and Production: Compulsory General Engineering Science (Engineering: Compulsory Energy Systems: Technical Comp | (German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 ser rry (German program, 7 sem erman program, 7 semeste erman program, 7 semeste plementary Course Core Stu | ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanica ester): Specialisation Mechanica er): Specialisation Mechanical Engi r): Specialisation Mechanical Engir | I Engineering, F Engineering, Foci Engineering, Foci al Engineering, II Engineering, F ineering, Focus P | ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials Focus Mechatroni roduct Developme |
| scale Assignment for the | General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (and Production: Compulsory General Engineering Science (Engineering: Compulsory Energy Systems: Technical Comp Engineering Science: Specialisat | (German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 sem rry (German program, 7 sem erman program, 7 semeste erman program, 7 semeste plementary Course Core Str ion Mechanical Engineering | ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanica ester): Specialisation Mechanica er): Specialisation Mechanical Engi r): Specialisation Mechanical Engir udies: Elective Compulsory : Compulsory | I Engineering, F Engineering, Foci Engineering, Foci al Engineering, II Engineering, F ineering, Focus P heering, Focus Th | ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials focus Mechatroni roduct Developme eoretical Mechani |
| scale Assignment for the | General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (and Production: Compulsory General Engineering Science (Engineering: Compulsory Energy Systems: Technical Comp Engineering Science: Specialisat | (German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 sem rry (German program, 7 sem erman program, 7 semeste erman program, 7 semeste plementary Course Core Str ion Mechanical Engineering | ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanica ester): Specialisation Mechanica er): Specialisation Mechanical Engi r): Specialisation Mechanical Engir | I Engineering, F Engineering, Foci Engineering, Foci al Engineering, II Engineering, F ineering, Focus P heering, Focus Th | ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials focus Mechatroni roduct Developme eoretical Mechani |
| scale Assignment for the | General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (and Production: Compulsory General Engineering Science (Engineering: Compulsory Energy Systems: Technical Com Engineering Science: Specialisat General Engineering Science (Engineering Science (Engineering Science)) | (German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 sem rry (German program, 7 sem erman program, 7 semeste erman program, 7 semeste plementary Course Core Str ion Mechanical Engineering iglish program, 7 semester) | ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanica ester): Specialisation Mechanica er): Specialisation Mechanical Engi r): Specialisation Mechanical Engir udies: Elective Compulsory : Compulsory | I Engineering, F Engineering, Foc Engineering, Foc al Engineering, F I Engineering, F ineering, Focus P heering, Focus Th | ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials Focus Mechatroni roduct Developme eoretical Mechani |
| scale Assignment for the | General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (and Production: Compulsory General Engineering Science (Engineering: Compulsory Energy Systems: Technical Com Engineering Science: Specialisat General Engineering Science (Engineering Science (Engineering Science)) | (German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 sem rry (German program, 7 sem erman program, 7 semeste erman program, 7 semeste plementary Course Core Str ion Mechanical Engineering iglish program, 7 semester) | ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanica ester): Specialisation Mechanica er): Specialisation Mechanical Engin c): Specialisation Mechanical Engin c): Specialisation Mechanical Engine | I Engineering, F Engineering, Foc Engineering, Foc al Engineering, F I Engineering, F ineering, Focus P heering, Focus Th | ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials Focus Mechatroni roduct Developme eoretical Mechani |
| scale Assignment for the | General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (and Production: Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering: Compulsory Energy Systems: Technical Comp Engineering Science: Specialisat General Engineering Science (Engineering Science) General Engineering Science (Engineering Science) | (German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 sem rry (German program, 7 sem erman program, 7 semeste plementary Course Core Str ion Mechanical Engineering iglish program, 7 semester) (English program, 7 sem | ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanica ester): Specialisation Mechanica er): Specialisation Mechanical Engin c): Specialisation Mechanical Engin c): Specialisation Mechanical Engine | I Engineering, F Engineering, Foc Engineering, Foc al Engineering, Foc I Engineering, Focus P heering, Focus Th eering: Compulson I Engineering, F | ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials focus Mechatroni roduct Developme eoretical Mechani |
| scale Assignment for the | General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (and Production: Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering: Compulsory Energy Systems: Technical Comp Engineering Science: Specialisat General Engineering Science (Engineering Science) General Engineering Science (Engineering Science) | (German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 sem rry (German program, 7 sem erman program, 7 semeste plementary Course Core Str ion Mechanical Engineering iglish program, 7 semester) (English program, 7 sem | ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanica ester): Specialisation Mechanica er): Specialisation Mechanical Engin clies: Elective Compulsory : Compulsory : Specialisation Mechanical Engine ester): Specialisation Mechanical Engine | I Engineering, F Engineering, Foc Engineering, Foc al Engineering, Foc I Engineering, Focus P heering, Focus Th eering: Compulson I Engineering, F | ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials focus Mechatroni roduct Developme eoretical Mechani |
| scale Assignment for the | General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (Gand Production: Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering: Science (Engineering Science: Specialisat General Engineering Science (Engineering Science (Engineering Science (General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Compulsory | (German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 sem ry (German program, 7 sem erman program, 7 semeste erman program, 7 semeste plementary Course Core Stu ion Mechanical Engineering iglish program, 7 seme English program, 7 semes | ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanica ester): Specialisation Mechanica er): Specialisation Mechanical Engin clies: Elective Compulsory : Compulsory : Specialisation Mechanical Engine ester): Specialisation Mechanical Engine | I Engineering, F Engineering, Foci Engineering, Foci al Engineering, Foci I Engineering, Focus P heering, Focus Th eering: Compulsor I Engineering, Focu | us Energy Syster us Aircraft Syster Focus Materials Focus Mechatroni roduct Developme eoretical Mechani |
| scale Assignment for the | General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (Gand Production: Compulsory General Engineering Science (Engineering: Compulsory Energy Systems: Technical Comp Engineering Science: Specialisat General Engineering Science (Engineering Science (Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory | (German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 seme ry (German program, 7 sem erman program, 7 semeste erman program, 7 semeste plementary Course Core Stu ion Mechanical Engineering iglish program, 7 seme English program, 7 semeste English program, 7 semeste | ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical nester): Specialisation Mechanica nester): Specialisation Mechanica ester): Specialisation Mechanical Engin (): Specialisation Mechanical Engine ester): Specialisation Mechanical Engine | I Engineering, F Engineering, Foci Engineering, Foci al Engineering, Foci I Engineering, Focus P heering, Focus Th eering: Compulsoi I Engineering, Foci Engineering, Foci | ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials Focus Mechatroni roduct Developme eoretical Mechani ry ocus Biomechani us Energy Syster us Aircraft Syste |
| scale Assignment for the | General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory General Engineering Science (Engineering Sciences: Compulso General Engineering Science (Compulsory General Engineering Science (Gand Production: Compulsory General Engineering Science (Engineering: Compulsory Energy Systems: Technical Comp Engineering Science: Specialisat General Engineering Science (Engineering Science (Engineering Science (General Engineering Science (General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Compulsory General Engineering Science (Engineering: Compulsory | (German program, 7 sem German program, 7 seme German program, 7 seme (German program, 7 seme ry (German program, 7 sem erman program, 7 semeste erman program, 7 semeste plementary Course Core Stu ion Mechanical Engineering iglish program, 7 seme English program, 7 semeste English program, 7 semeste | ester): Specialisation Mechanica ster): Specialisation Mechanical I ster): Specialisation Mechanical I nester): Specialisation Mechanica nester): Specialisation Mechanica er): Specialisation Mechanical Engin (): Specialisation Mechanical Engin (): Specialisation Mechanical Engine ester): Specialisation Mechanical Engine ester): Specialisation Mechanical Engine (): Specialisation Mechanical Engine | I Engineering, F Engineering, Foci Engineering, Foci al Engineering, Foci I Engineering, Focus P heering, Focus Th eering: Compulsoi I Engineering, Foci Engineering, Foci | ocus Biomechani us Energy Syster us Aircraft Syste Focus Materials Focus Mechatroni roduct Developme eoretical Mechani ry ocus Biomechani us Energy Syster us Aircraft Syste |

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 Mechanical Engineering: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory

| ourse L0264: Advanced Me | chanical Engineering Design II |
|--------------------------|--|
| Тур | |
| Hrs/wk | 2 |
| CP | 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 |
| | 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. |
| | Sowie weitere Bücher zu speziellen Themen |
| | · |

| Course L0265: Advanced Me | 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 | |

| τνρ | Lecture |
|-------------------|--|
| Hrs/wk | |
| CP | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| | Prof. Dieter Krause, Prof. Otto von Estorff |
| Language | |
| Cycle | |
| | 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 |
| | 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. |
| | Bubbel, Taschenbuch für den Maschnenbau, Glote, K. H., Feldhäsen, J. (1939.), 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, aktu |
| | Auflage. |
| | Roloff/Matek Maschinenelemente; Wittel, H., Muhs, D., Jannasch, D., Voßiek, J., Springer Vieweg, aktuelle Auflage. |
| | |

| Course L0263: Advanced Me | Course L0263: Advanced Mechanical Engineering Design I | |
|---------------------------|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| CP | 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 |
| Heat Transfer (L0458) | | Lecture | 3 | 4 |
| Heat Transfer (L0459) | | Recitation Section (large) | 2 | 2 |
| Module Responsible | Dr. Andreas Moschallski | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Technical Thermodynamics I, II and Fluid Dynamics | | | |
| Knowledge Educational Objectives | After taking part successfully, students have reached the folio | wing loarning rocults | | |
| Professional Competence | Arter taking part successionly, students have reached the fond | | | |
| Knowledge | The students are able to | | | |
| | - describe the different physical mechanism of Heat Transfer, | | | |
| | - explain the technical terms, | | | |
| | - to analyse comlex heat transfer processes in a critical way. | | | |
| Skills | The students are able to | | | |
| | - understand the physics of Heat Transfer, | | | |
| | - calculate and evaluate complex Heat Transfer processes, | | | |
| | - solve excersises self-consistent and in small groups. | | | |
| Personal Competence | | | | |
| Social Competence | The students are able to discuss in small groups and develop | an approach. | | |
| Autonomy | The students are able to develop a complex problem self-con with other students is given. | sistent and analyse the results i | n a critical way. A | qualified exchan |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 semeste | er): Specialisation Mechanical I | Engineering, Foc | us Energy Systen |
| Following Curricula | Compulsory | | | |
| | General Engineering Science (German program, 7 semester): | | | - |
| | General Engineering Science (German program, 7 semester): | Specialisation Mechanical Engir | ieering, Focus Th | eoretical Mechanio |
| | Engineering: Compulsory | | | |
| | Energy Systems: Technical Complementary Course Core Stud | | | |
| | General Engineering Science (English program, 7 semeste | er): Specialisation Mechanical E | ngineering, Foci | us Energy Systen |
| | Compulsory | | anian Canada | |
| | General Engineering Science (English program, 7 semester): 9 | | ering: Compulsor | У |
| | Mechanical Engineering: Specialisation Energy Systems: Com | · - | | |
| | Mechanical Engineering: Specialisation Theoretical Mechanica | u Fuqineering: Flective Compuls | | |

| Course L0458: Heat Transfer | |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 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 (steady and unsteady) , Convective Heat Transfer (natural convection, forced convection), Two-phase Heat Transfer (evaporation, condensation), Thermal Radiation, Heat Transfer on a thermodynamic view, thermotechnical devices, measures of temperature and heat flux |
| Literature | Herwig, H.; Moschallski, A.: Wärmeübertragung, 4. Auflage, Springer Vieweg Verlag, Wiesbaden, 2019 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 | ourse L0459: Heat Transfer | |
|-----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| CP | 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 | | Tree | Line (sule | СР |
| Computational Fluid Dynamics I (L0 | 1235) | Typ Lecture | Hrs/wk 2 | 3 |
| Computational Fluid Dynamics I (LC | | Recitation Section (large) | 2 | 3 |
| Module Responsible | Prof. Thomas Rung | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | Mathematical Methods for Engineers | | | |
| ······································ | Fundamentals of Differential/integral of | alculus and series expansions | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning results | | |
| Professional Competence | ······ | · · · · · · · · · · · · · · · · · · · | | |
| | The students are able to list the basic numer | ics of partial differential equations | | |
| Kilowicage | The statents are able to list the basic human | ies of partial afferential equations. | | |
| | | | | |
| Skille | The students are able develop appropriate p | umerical integration in space and time for the g | noverning partial d | ifferential equation |
| SKIIS | They can code computational algorithms in a | | jovenning partial a | incrential equation |
| | They can code computational algorithms in a | Statuta way. | | |
| | | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | The students can arrive at work results in gro | oups and document them. | | |
| | | | | |
| | | | | |
| Autonomy | The students can independently analyse app | roaches to solving specific problems. | | |
| | | | | |
| | | | | |
| | | | | |
| We what a set has the same | la des en destr Charles Times 124. Charles Times in l | | | |
| | Independent Study Time 124, Study Time in I | Lecture 56 | | |
| Credit points | | | | |
| Course achievement | None | | | |
| | Written exam | | | |
| Examination duration and | 2h | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German progra | am, 7 semester): Specialisation Mechanical Eng | ineering, Focus Th | eoretical Mechan |
| Following Curricula | Engineering: Elective Compulsory | | | |
| | | gram, 7 semester): Specialisation Mechanical | Engineering, Foc | us Aircraft Syste |
| | Engineering: Elective Compulsory | | | |
| | | gram, 7 semester): Specialisation Mechanical | Engineering, Foc | us Energy Syste |
| | Elective Compulsory | | | |
| | | am, 7 semester): Specialisation Naval Architectu | | |
| | | am, 7 semester): Specialisation Energy and Env | iromentai Engineei | ring: Compulsory |
| | Energy Systems: Technical Complementary C | | omontal Engineer | ing: Compulsors |
| | | m, 7 semester): Specialisation Energy and Envir | - | |
| | | ram, 7 semester): Specialisation Mechanical | Engineering, FOC | us Literyy Syster |
| | Elective Compulsory General Engineering Science (English program | m, 7 semester): Specialisation Naval Architectu | re: Compulson | |
| | | rram, 7 semester): Specialisation Naval Architectu | | us Aircraft Svete |
| | Engineering: Elective Compulsory | nam, / semester). Specialisation Mechanical | Ligineening, FOC | as Ancidit Syste |
| | Engineering, Elective CUIIDUISULV | | | |
| | | v Systems: Elective Compulsory | | |
| | Mechanical Engineering: Specialisation Energ | | | |
| | Mechanical Engineering: Specialisation Energ | aft Systems Engineering: Elective Compulsory | | |

| Course L0235: Computationa | al Fluid Dynamics I |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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. |
| | Partial differential equations Foundations of finite numerical approximations Computation of potential flows Introduction of finite-differences Approximation of convective, diffusive and transient transport processes Formulation of boundary conditions and initial conditions Assembly and solution of algebraic equation systems Facets of weighted -residual approaches Finite volume methods Basics of grid generation |
| Literature | Ferziger and Peric: Computational Methods for Fluid Dynamics, Springer |

| Course L0419: Computationa | urse 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 |
| Numerical Mathematics I (L0417) | | Lecture | 2 | 3 |
| Numerical Mathematics I (L0418) | | Recitation Section (small) | 2 | 3 |
| Module Responsible | Prof. Sabine Le Borne | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mathematik I + II for Engineering Students (germ | an or english) or Analysis & Linear Al | aebra I + II for Te | chnomathematic |
| Knowledge | basic MATLAB/Python knowledge | | | |
| | | | | |
| | After taking part successfully, students have reached th | e following learning results | | |
| Professional Competence | Churd and a sur a blacks | | | |
| Knowleage | Students are able to | | | |
| | name numerical methods for interpolation, integ | ration, least squares problems, eigenv | value problems, r | onlinear root fin |
| | problems and to explain their core ideas, | | | |
| | repeat convergence statements for the numerical | | | |
| | explain aspects for the practical execution of nur | nerical methods with respect to comp | utational and stor | rage complexitx. |
| | | | | |
| | | | | |
| Skills | Students are able to | | | |
| | implement, apply and compare numerical method | ds using MATLAB/Python, | | |
| | justify the convergence behaviour of numerical r | nethods with respect to the problem a | nd solution algori | thm, |
| | select and execute a suitable solution approach | or a given problem. | | |
| Personal Competence | | | | |
| • | Students are able to | | | |
| Social competence | | | | |
| | work together in heterogeneously composed tea | ms (i.e., teams from different study p | rograms and bac | kground knowled |
| | explain theoretical foundations and support each | other with practical aspects regarding | g the implementa | tion of algorithm |
| Autonomy | Students are capable | | | |
| , | | | | |
| | to assess whether the supporting theoretical and | | individually or in | i a team, |
| | to assess their individual progess and, if necessa | ry, to ask questions and seek help. | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 minutes | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 seme | ster): Specialisation Computer Science | e: Compulsory | |
| Following Curricula | General Engineering Science (German program, 7 | semester): Specialisation Mechanic | al Engineering, | Focus Material |
| | Engineering Sciences: Compulsory | | | |
| | General Engineering Science (German program, 7 seme | | | |
| | General Engineering Science (German program, 7 | semester): Specialisation Mechanica | l Engineering, F | ocus Biomechai |
| | Compulsory | octor), Specialisation Mechanical Engli | pooring Focus Th | oprotical Mocha |
| | General Engineering Science (German program, 7 seme Engineering: Compulsory | .ster). Specialisation Methanital Engli | icening, rocus III | corecicar Mecilal |
| | General Engineering Science (German program, 7 s | emester): Specialisation Mechanical | Engineering Foo | us Aircraft Svst |
| | Engineering: Elective Compulsory | | | |
| | General Engineering Science (German program, 7 sem | ester): Specialisation Mechanical Engi | neering, Focus M | echatronics: Elec |
| | Compulsory | | J, | |
| | | emester): Specialisation Mechanical I | Engineering, Foc | us Energy Syste |
| | General Engineering Science (German program, 7 s | | | |
| | Elective Compulsory | | | |
| | | rocess Engineering: Elective Compulso | ory | |
| | Elective Compulsory | | ory | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop | matics: Elective Compulsory | | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mathe | matics: Elective Compulsory | | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mathe Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com | matics: Elective Compulsory ngineering Science: Elective Compulso | | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mathe Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory | matics: Elective Compulsory ngineering Science: Elective Compulso | | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mathe Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory | matics: Elective Compulsory ngineering Science: Elective Compulso pulsory | | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mathe Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 seme | matics: Elective Compulsory ngineering Science: Elective Compulso pulsory ster): Core Qualification: Compulsory | bry | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mather Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme | matics: Elective Compulsory ngineering Science: Elective Compulso pulsory ster): Core Qualification: Compulsory ster): Specialisation Computer Science | ry : Compulsory | ocus Piomocha |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mather Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme | matics: Elective Compulsory ngineering Science: Elective Compulso pulsory ster): Core Qualification: Compulsory ster): Specialisation Computer Science | ry : Compulsory | ocus Biomechai |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mather Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme Compulsory | matics: Elective Compulsory ngineering Science: Elective Compulso pulsory ster): Core Qualification: Compulsory ster): Specialisation Computer Science semester): Specialisation Mechanica | ory : Compulsory I Engineering, F | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mather Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme | matics: Elective Compulsory ngineering Science: Elective Compulso pulsory ster): Core Qualification: Compulsory ster): Specialisation Computer Science semester): Specialisation Mechanica | ory : Compulsory I Engineering, F | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mather Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme Sciences: Compulsory | matics: Elective Compulsory ngineering Science: Elective Compulso pulsory ster): Core Qualification: Compulsory ster): Specialisation Computer Science semester): Specialisation Mechanical ster): Specialisation Mechanical Engine | ory : Compulsory I Engineering, F eering, Focus Mat | erials in Enginee |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mather Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme Sciences: Compulsory General Engineering Science (English program, 7 seme Sciences: Compulsory General Engineering Science (English program, 7 seme Sciences: Compulsory | matics: Elective Compulsory ngineering Science: Elective Compulso pulsory ster): Core Qualification: Compulsory ster): Specialisation Computer Science semester): Specialisation Mechanical ster): Specialisation Mechanical Engine | ory : Compulsory I Engineering, F eering, Focus Mat | erials in Enginee |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mather Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme Sciences: Compulsory | matics: Elective Compulsory ngineering Science: Elective Compulso pulsory ster): Core Qualification: Compulsory ster): Specialisation Computer Science semester): Specialisation Mechanical ster): Specialisation Mechanical Engine ster): Specialisation Mechanical Engine | : Compulsory I Engineering, F eering, Focus Mat eeering, Focus Th | eerials in Enginee eoretical Mechae |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Biop Computer Science: Specialisation Computational Mather Computer Science: Specialisation II. Mathematics and E Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Com Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme General Engineering Science (English program, 7 seme Sciences: Compulsory General Engineering Science (English program, 7 seme Sciences: Compulsory General Engineering Science (English program, 7 seme Sciences: Compulsory General Engineering Science (English program, 7 seme Sciences: Compulsory | matics: Elective Compulsory ngineering Science: Elective Compulso pulsory ster): Core Qualification: Compulsory ster): Specialisation Computer Science semester): Specialisation Mechanical ster): Specialisation Mechanical Engine ster): Specialisation Mechanical Engine | : Compulsory I Engineering, F eering, Focus Mat eering, Focus Th eering: Compulso | erials in Enginee eoretical Mechai Y |

Computational Science and Engineering: Core Qualification: Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Mechanical Engineering: Specialisation Mechatronics: Elective Compulsory

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

Process Engineering: Specialisation Process Engineering: Elective Compulsory

| Course L0417: Numerical Ma | thematics I | |
|----------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | | |
| CP | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Sabine Le Borne | |
| Language | EN | |
| Cycle | WiSe | |
| Content | Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss quadrature, adaptive quadrature | |
| Literature | Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer | |

| Course L0418: Numerical Ma | Irse L0418: Numerical Mathematics I | | |
|----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| CP | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Sabine Le Borne, Dr. Jens-Peter Zemke | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | | |
|--|--|--|---------------------|-------------------|--|
| Title | | Тур | Hrs/wk | СР | |
| Production Engineering I (L0608) | | Lecture | 2 | 2 | |
| Production Engineering I (L0612) | | Recitation Section (large) | 1 | 1 | |
| Production Engineering II (L0610) Production Engineering II (L0611) | | Lecture Recitation Section (large) | 2 | 2 1 | |
| Module Responsible | Prof Wolfgang Hintze | Recitation Section (large) | 1 | 1 | |
| - | None | | | | |
| - | no course assessments required | | | | |
| Knowledge | | | | | |
| - | internship recommended | | | | |
| Educational Objectives | After taking part successfully, students hav | e reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | Students are able to | | | | |
| | | | | | |
| | name basic criteria for the selection | | | | |
| | name the main groups of Manufactur | | | | |
| | name the application areas of difference | | | | |
| | - | isadvantages of the different manufacturing proc | | | |
| | | rties and kinematic variables and requirements for | or tools, workpiece | and process. | |
| | explain the essential models of manual | ufacturing technology. | | | |
| | | | | | |
| ci " | C 1 1 1 | | | | |
| SKIIIS | Students are able to | | | | |
| | select manufacturing processes in ad | ccordance with the requirements. | | | |
| | design manufacturing processes for | simple tasks to meet the required tolerances of t | he component to b | pe produced. | |
| | assess components in terms of their | production-oriented construction. | | | |
| | | | | | |
| | | | | | |
| Personal Competence | | | | | |
| Social Competence | Students are able to | | | | |
| | develop solutions in a production environment with qualified personnel at technical level and represent decisions. | | | | |
| | • develop solutions in a production en | with qualities personnel at technical le | ver and represent | decisions. | |
| | | | | | |
| Autonomy | Students are able to | | | | |
| | - interret independently the percent | | | | |
| | interpret independently the manufaction of the second secon | | | | |
| | assess own strengths and weakness | | | | |
| | assess their learning progress and d | | | | |
| | assess possible consequences of the | ir actions. | | | |
| | | | | | |
| Workload in Hours | Independent Study Time 96, Study Time in | Lecture 84 | | | |
| workload in nours | independent study nine 90, study nine in | | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | | | | | |
| Examination duration and | 120 min | | | | |
| scale | | | | | |
| - | | gram, 7 semester): Specialisation Mechanical En | gineering, Focus I | Product Developn | |
| Following Curricula | and Production: Compulsory | | | | |
| | | ram, 7 semester): Specialisation Mechanical Eng | ineering, Focus Th | neoretical Mechar | |
| | Engineering: Elective Compulsory | | | | |
| | Digital Mechanical Engineering: Core Qualif | ication: Compulsory | | | |
| | Engineering Science: Specialisation Mechar | nical Engineering: Compulsory | | | |
| | General Engineering Science (English progr | am, 7 semester): Specialisation Mechanical Engir | neering: Compulso | ory | |
| | General Engineering Science (English prog | ram, 7 semester): Specialisation Mechanical Eng | ineering, Focus Th | neoretical Mechar | |
| | Engineering: Elective Compulsory | | | | |
| | Green Technologies: Energy, Water, Climat | e: Specialisation Energy Technology: Elective Cor | npulsory | | |
| | Logistics and Mobility: Specialisation Produc | ction Management and Processes: Compulsory | | | |
| | Logistics and Mobility: Specialisation Engine | | | | |
| | Mechanical Engineering: Core Qualification: | | | | |
| | incentation Engineering. core Qualification. | | | | |
| | Mechatronics: Core Qualification: Compulso | | | | |

| Course L0608: Production En | igineering I |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 En | ourse L0612: Production Engineering I | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| CP | 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 En | igineering II |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 En | urse L0611: Production Engineering II | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| CP | 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 | | |

| | puter Engineering | | | |
|--|--|---|---|--|
| Courses | | | | |
| Title | Тур | Hrs/wk | СР | |
| Computer Engineering (L0321) Computer Engineering (L0324) | Lecture Recitation Section (small) | 3 1 | 4 2 | |
| Module Responsible | | Ţ | Z | |
| Admission Requirements | | | | |
| | Basic knowledge in electrical engineering | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached 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-le programming down to gates. The module includes the following topics: Introduction | | | |
| | Combinational logic: Gates, Boolean algebra, Boolean functions, hardware synthesi 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 | | tworks | |
| | Memories: Memory hierarchies, SRAM, DRAM, caches Input/output: I/O from the perspective of the CPU, principles of passing data, point- | to-point connections | s, busses | |
| Skills | The students perceive computer systems from the architect's perspective, i.e., they identify the internal structure and the physic composition of computer systems. The students can analyze, how highly specific and individual computers can be built based of collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers 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 compu- system and the software executed on it. In particular, they shall understand the consequences that the execution of software layers on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evalu | | | |
| | the impact that these low abstraction levels have on an entire system's performance and | to propose feasible | options. | |
| Personal Competence | 9 | | | |
| 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 | i 6 | | | |
| Course achievement | | | | |
| From the state of | Yes 10 % Excercises | | | |
| | | | | |
| scale | 90 minutes, contents of course and labs | | | |
| | General Engineering Science (German program, 7 semester): Specialisation Computer Sci | ience: Compulsory | | |
| | General Engineering Science (German program, 7 semester): Specialisation Civil Engineer | | | |
| | General Engineering Science (German program, 7 semester): Specialisation Process Engir General Engineering Science (German program, 7 semester): Specialisation Mecha Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanic Engineering: Compulsory | nical Engineering, | Focus Mechatron cus Aircraft Syste | |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical E Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mech | | | |
| | Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical and Production: Compulsory | Engineering, Focus | Product Developm | |
| | | | | |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanic Compulsory | | | |
| | | nical Engineering, | | |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Mecha Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Archite General Engineering Science (German program, 7 semester): Specialisation Biomedical Er General Engineering Science (German program, 7 semester): Specialisation Bioprocess Er General Engineering Science (German program, 7 semester): Specialisation Electrical Eng General Engineering Science (German program, 7 semester): Specialisation Electrical Eng General Engineering Science (German program, 7 semester): Specialisation Green Techno Compulsory | nical Engineering, cture: Compulsory ngineering: Compuls ngineering: Compuls jineering: Compulso | Focus Biomechan Fory ory TY | |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Mecha Compulsory General Engineering Science (German program, 7 semester): Specialisation Naval Archite General Engineering Science (German program, 7 semester): Specialisation Biomedical Er General Engineering Science (German program, 7 semester): Specialisation Bioprocess Er General Engineering Science (German program, 7 semester): Specialisation Electrical Eng General Engineering Science (German program, 7 semester): Specialisation Electrical Eng General Engineering Science (German program, 7 semester): Specialisation Green Techno | nical Engineering, ecture: Compulsory ngineering: Compuls ngineering: Compulso plogies, Focus Renew | Focus Biomechar ory ory ry vable Energy: Elec | |

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

| Course L0321: Computer Eng | Course L0321: Computer Engineering | | |
|----------------------------|---|--|--|
| Тур | cture | | |
| Hrs/wk | | | |
| CP | 4 | | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | | |
| Lecturer | Prof. Heiko Falk | | |
| Language | DE/EN | | |
| 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 Eng | ourse L0324: Computer Engineering | |
|----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE/EN | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|-------------------------------------|--|---|---------------------|----------------------|
| Title | | Turn | Line (suite | СР |
| Electrical Machines and Actuators | (10293) | Typ Lecture | Hrs/wk 3 | 4 |
| Electrical Machines and Actuators | | Recitation Section (large) | 2 | 2 |
| Module Responsible | Prof. Thorsten Kern | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basics of mathematics, in particular comple | exe numbers, integrals, differentials | | |
| Knowledge | Basics of electrical engineering and mecha | nical ongineering | | |
| | | | | |
| Educational Objectives | After taking part successfully, students hav | e reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students can to draw and explain the basic | principles of electric and magnetic fields. | | |
| | They can describe the function of the | standard types of electric machines and pres | ent the correspon | ding equations a |
| | | ves they can explain the major parameters of the | | |
| | from the power grid to the driven engine. | | 5, , | 2 |
| | | | | |
| Skills | | ional electric and magnetic fields in particular f | erromagnetic circu | uits with air gap. F |
| | this they apply the usual methods of the de | sign auf electric machines. | | |
| | They can calulate the operational perform | ance of electric machines from their given char | acteristic data and | d selected quantiti |
| | and characteristic curves. They apply the u | sual equivalent circuits and graphical methods. | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | e none | | | |
| Autonomy | | te electric and magnatic fields for applications. T | | |
| | | achines from the charactersitic data and theyca | n calculate thereo | f selected quantit |
| | and characteristic curves. | | | |
| | | | | |
| Warkland in Hours | Independent Study Time 110, Study Time i | a Locturo 70 | | |
| | Independent Study Time 110, Study Time in | T Lecture 70 | | |
| Credit points Course achievement | | | | |
| | | | | |
| | Subject theoretical and practical work Design of four machines and actuators, rev | iow of docign files | | |
| scale | Design of four machines and actuators, rev | lew of design files | | |
| | General Engineering Science (German prog | ram, 7 semester): Specialisation Electrical Engine | eering: Elective Co | mpulsory |
| Following Curricula | | ogram, 7 semester): Specialisation Electrical English | | |
| j | Compulsory | | 5 5 5, 5 | |
| | General Engineering Science (German p | rogram, 7 semester): Specialisation Mechanic | cal Engineering, I | Focus Mechatronio |
| | Compulsory | | | |
| | General Engineering Science (German prog | ram, 7 semester): Specialisation Mechanical Eng | ineering, Focus Th | eoretical Mechani |
| | Engineering: Elective Compulsory | | | |
| | Digital Mechanical Engineering: Core Qualif | | | |
| | Electrical Engineering: Core Qualification: E | | | |
| | Energy and Environmental Engineering: Col | | nooring: Elective C | |
| | | am, 7 semester): Specialisation Mechanical Engine Specialisation Energy Technology: Elective Col | | ompulsory |
| | Logistics and Mobility: Specialisation Engine | e: Specialisation Energy Technology: Elective Con pering Science: Elective Compulsory | npaisory | |
| | | Planning and Systems: Elective Compulsory | | |
| | | ction Management and Processes: Elective Comp | ulsory | |
| | Mechanical Engineering: Core Qualification: | | | |
| | Mechatronics: Core Qualification: Compulso | | | |
| | Technomathematics: Specialisation III. Engi | | | |
| | Engineering and Management - Major in Lo | gistics and Mobility: Specialisation Traffic Plannin | g and Systems: Ele | ective Compulsory |
| | | | | |
| | Engineering and Management - Major in I | ogistics and Mobility: Specialisation Production | Management and | Processes: Electi |

| Course L0293: Electrical Mac | hines and Actuators |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Thorsten Kern, Dennis Kähler |
| Language | DE |
| Cycle | SoSe |
| Content | Electric field: Coulomb's law, flux (field) line, work, potential, capacitor, energy, force, capacitive actuators |
| | Magnetic field: force, flux line, Ampere´s law, field at bounderies, flux, magnetic circuit, hysteresis, induction, self-induction, mutual inductance, transformer, electromagnetic actuators |
| | Synchronous machines, construction and layout, equivalent single line diagrams, no-load and short-cuircuit characteristics, vector diagrams, motor and generator operation, stepper motors |
| | 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 (squirrel-cage vs. sliprings), |
| | Drives with variable speed, inverter fed operation, special drives |
| 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 and Actuators | | |
|---|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Thorsten Kern, Dennis Kähler | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|-----------------------------------|--|--|------------------------|-------------------|
| Title | | Тур | Hrs/wk | СР |
| Modeling, Simulation and Optimiza | tion (L2446) | Integrated Lecture | 4 | 6 |
| Module Responsible | Prof. Benedikt Kriegesmann | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Sound knowledge of engineering mathematics, | engineering mechanics and fluid mechanics | S | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have rea | ched the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students will have an overview of various tech | nical problems and the differential equation | ons, which describe | them. Students |
| | gave an overview of different solution approach | es and for which kind of problems they can | be used for. | |
| Skille | Students are able to solve different technical pro | ablems with the introduced discretization m | acthode | |
| SKIIIS | Students are able to solve unreferit technical pr | blems with the incloduced discretization in | lethous. | |
| Personal Competence | | | | |
| Social Competence | The students are able to discuss problems and j | ointly develop solution strategies. | | |
| Δυτοροφγ | The students are able to develop solution strate | gies for complex problems self-consistent a | and critically analyse | results |
| , lateriority | | | and enclosing analyse | |
| Workload in Hours | Independent Study Time 124, Study Time in Lec | ture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Oral exam | | | |
| Examination duration and | 30 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, | 7 semester): Specialisation Mechanical En | gineering, Focus Th | eoretical Mechani |
| Following Curricula | Engineering: Compulsory | | | |
| | Engineering Science: Core Qualification: Compu | lsory | | |
| | General Engineering Science (English program, | 7 semester): Core Qualification: Compulsor | У | |
| | General Engineering Science (English program, | 7 semester): Specialisation Mechanical En | gineering, Focus Th | eoretical Mechani |
| | Engineering: Elective Compulsory | | | |
| | Mechanical Engineering: Specialisation Theoreti | cal Mechanical Engineering: Elective Comp | ulsory | |
| | Mechanical Engineering: Specialisation Theoreti | cal Mechanical Engineering: Compulsory | | |
| | Technomathematics: Specialisation III. Engineer | ing Science: Elective Compulsory | | |

| Course L2446: Modeling, Simulation and Optimization | | | |
|---|---|--|--|
| Тур | Integrated Lecture | | |
| Hrs/wk | 4 | | |
| CP | 6 | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | |
| Lecturer | Prof. Benedikt Kriegesmann, Prof. Thomas Rung, Prof. Alexander Düster, Prof. Robert Seifried | | |
| Language | EN | | |
| Cycle | SoSe | | |
| Content | Partial Differential Equations in technical problems Overview of modelling approaches Finite Approximation Methods - Finite Differences / Elements / Volumes Introduction to the Discrete Element Method Numerical methods for time dependent problems Gradient-based optimization | | |
| Literature | Michael Schäfer, Computational Engineering - Introduction to Numerical Methods, Springer. | | |

| Module M0854: Math | ematics IV | | | |
|--|--|--|---|--|
| | | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Differential Equations 2 (Partial Dif | | Lecture | 2 | 1 |
| Differential Equations 2 (Partial Dif | | Recitation Section (small) | 1 | 1 |
| Differential Equations 2 (Partial Dif Complex Functions (L1038) | lefential Equations) (E1045) | Recitation Section (large) Lecture | 2 | 1 |
| Complex Functions (L1030) | | Recitation Section (small) | 1 | 1 |
| Complex Functions (L1042) | | Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof Anusch Taraz | | | |
| | | | | |
| Admission Requirements | | | | |
| Recommended Previous | Mathematics 1 - III | | | |
| Knowledge | | | | |
| | After taking part successfully, students have re- | ached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students can name the basic concents in | Mathematics IV. They are able to explain ther | n using appropri | ato oxamplos |
| | | | | |
| | - | between these concepts. They are capable | or muscrating th | ese connections wi |
| | the help of examples. | | | |
| | They know proof strategies and can repr | oduce them. | | |
| | | | | |
| | | | | |
| Skills | | matics N/ with the belo of the concents studie | d in this source | Managuan they a |
| | | natics IV with the help of the concepts studie | ea in this course | . Moreover, they a |
| | capable of solving them by applying esta | | | |
| | | further logical connections between the conce | | |
| | | develop and execute a suitable approach, a | nd are able to c | ritically evaluate t |
| | results. | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Social competence | | ms. They are capable to use mathematics as a | a common langu | age. |
| | In doing so, they can communicate new | concepts according to the needs of their coop | erating partners | . Moreover, they c |
| | design examples to check and deepen th | e understanding of their peers. | | |
| | | | | |
| | | | | |
| Autonomy | | | | |
| Autonomy | | inderstanding of complex concepts on their o | wn. They can sp | ecify open questio |
| | precisely and know where to get help in | solving them. | | |
| | Students have developed sufficient pers | sistence to be able to work for longer period | s in a goal-orien | ted manner on ha |
| | problems. | | | |
| | | | | |
| | | | | |
| Werkleed in Hours | Independent Study Time CO. Study Time in Load | 110 | | |
| | Independent Study Time 68, Study Time in Lect | ule 112 | | |
| Credit points | 0 | | | |
| | | | | |
| Course achievement | | | | |
| | None Written exam | | | |
| Examination | | tial Equations 2) | | |
| Examination | Written exam | tial Equations 2) | | |
| Examination Examination duration and scale | Written exam | · | ring: Compulsor | y |
| Examination Examination duration and scale Assignment for the | Written exam 60 min (Complex Functions) + 60 min (Differen | , 7 semester): Specialisation Electrical Enginee | | - |
| Examination Examination duration and scale Assignment for the | Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program | , 7 semester): Specialisation Electrical Enginee | | - |
| Examination Examination duration and scale Assignment for the | Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German progr | , 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica | l Engineering, | - |
| Examination Examination duration and scale Assignment for the | Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program | , 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architecture | Engineering, | Focus Mechatronic |
| Examination Examination duration and scale Assignment for the | Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program | , 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architecture | Engineering, | Focus Mechatronio |
| Examination Examination duration and scale Assignment for the | Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory | , 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architectur , 7 semester): Specialisation Mechanical Engin | Engineering, | Focus Mechatronio |
| Examination Examination duration and scale Assignment for the | Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa | , 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architectur , 7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory | Engineering, | Focus Mechatronio |
| Examination Examination duration and scale Assignment for the | Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp | , 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architectur , 7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory pulsory | I Engineering, e: Compulsory leering, Focus Th | Focus Mechatronic |
| Examination Examination duration and scale Assignment for the | Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, | , 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architecture , 7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory pulsory 7 semester): Specialisation Electrical Engineer | I Engineering, e: Compulsory leering, Focus Th ing: Compulsory | Focus Mechatronic |
| Examination Examination duration and scale Assignment for the | Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, | , 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architecture , 7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory pulsory 7 semester): Specialisation Electrical Engineer | I Engineering, e: Compulsory leering, Focus Th ing: Compulsory | Focus Mechatronic |
| Examination Examination duration and scale Assignment for the | Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, Compulsory | , 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architecture , 7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory pulsory 7 semester): Specialisation Electrical Engineer am, 7 semester): Specialisation Mechanical | I Engineering, e: Compulsory leering, Focus Th ring: Compulsory I Engineering, T | Focus Mechatronic |
| Examination Examination duration and scale Assignment for the | Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, General Engineeri | , 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architecture , 7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory pulsory 7 semester): Specialisation Electrical Engineer am, 7 semester): Specialisation Mechanical | I Engineering, e: Compulsory leering, Focus Th ring: Compulsory I Engineering, T | Focus Mechatronio |
| Examination Examination duration and scale Assignment for the | Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, Compulsory | , 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architecture , 7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory pulsory 7 semester): Specialisation Electrical Engineer am, 7 semester): Specialisation Mechanical | I Engineering, e: Compulsory leering, Focus Th ring: Compulsory I Engineering, T | Focus Mechatronio |
| Examination Examination duration and scale Assignment for the | Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program Compulsory General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, General Engineeri | 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica ,7 semester): Specialisation Naval Architecture ,7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory pulsory 7 semester): Specialisation Electrical Engineer am, 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical Engin | I Engineering, e: Compulsory leering, Focus Th ring: Compulsory I Engineering, T eering, Focus Th | Focus Mechatronic neoretical Mechanic Focus Mechatronic neoretical Mechanic |
| Examination Examination duration and scale Assignment for the | Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, Engineering: Compulsory | 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica ,7 semester): Specialisation Naval Architecture ,7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory pulsory 7 semester): Specialisation Electrical Engineer am, 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical Engin | I Engineering, e: Compulsory leering, Focus Th ring: Compulsory I Engineering, T eering, Focus Th | Focus Mechatronic neoretical Mechanic Focus Mechatronic neoretical Mechanic |
| Examination Examination duration and scale Assignment for the | Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, General Engineering Science (English program, Compulsory General Engineering Science (English program, Engineering: Compulsory Computational Science and Engineering: Specie | , 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architecture , 7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory pulsory 7 semester): Specialisation Electrical Engineer am, 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical Engin al semester): Specialisation Mechanical Engin and Mathematics & Engineering Science onics: Compulsory | I Engineering, e: Compulsory leering, Focus Th ring: Compulsory I Engineering, I eering, Focus Th :: Elective Compu | Focus Mechatronic neoretical Mechanic Focus Mechatronic neoretical Mechanic |
| Examination Examination duration and scale Assignment for the | Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, General Engineering Science (English program, Compulsory General Engineering Science (English program, Engineering: Compulsory Computational Science and Engineering: Specialisation Mechatr | , 7 semester): Specialisation Electrical Enginee am, 7 semester): Specialisation Mechanica , 7 semester): Specialisation Naval Architecture , 7 semester): Specialisation Mechanical Engin al Mathematics: Elective Compulsory pulsory 7 semester): Specialisation Electrical Engineer am, 7 semester): Specialisation Mechanical 7 semester): Specialisation Mechanical Engin al semester): Specialisation Mechanical Engin and Mathematics & Engineering Science onics: Compulsory | I Engineering, e: Compulsory leering, Focus Th ring: Compulsory I Engineering, I eering, Focus Th :: Elective Compu | Focus Mechatronic neoretical Mechanic Focus Mechatronic neoretical Mechanic |
| Examination Examination duration and scale Assignment for the | Written exam 60 min (Complex Functions) + 60 min (Differen General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program General Engineering Science (German program Engineering: Elective Compulsory Computer Science: Specialisation Computationa Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, General Engineering Science (English program, Engineering: Compulsory Computational Science and Engineering: Special Mechanical Engineering: Specialisation Mechatr Mechanical Engineering: Specialisation Theoret | 7 semester): Specialisation Electrical Engineeram, 7 semester): Specialisation Mechanica 7 semester): Specialisation Naval Architecture, 7 semester): Specialisation Mechanical Engineral Mathematics: Elective Compulsory 7 semester): Specialisation Electrical Engineeram, 7 semester): Specialisation Mechanical Engineeram, 8 semester): Specialisation Mechanical Engineeram, 8 semester): Specialisation Mechanical Engineeram, 9 semester): Sp | I Engineering, e: Compulsory leering, Focus Th ring: Compulsory I Engineering, I eering, Focus Th :: Elective Compu | Focus Mechatronic neoretical Mechanic Focus Mechatronic neoretical Mechanic |

| Course L1043: Differential Ec | quations 2 (Partial Differential Equations) |
|-------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 |
| Literature | 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 http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html |

| Course L1044: Differential E | 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 Fund | tions |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 |
| Literature | 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 |
| | http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html |

| Course L1041: Complex Functions | |
|---------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| CP | 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 Func | tions |
|----------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| CP | 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 |

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: Funda | amentals of Materials Science | | | |
|--|--|---|---|--|
| Courses | | | | |
| Title Fundamentals of Materials Science Fundamentals of Materials Science | l (L1085) Il (Advanced Ceramic Materials, Polymers and Composites) (L0506) | Typ Lecture Lecture | Hrs/wk 2 2 | CP 2 2 |
| Physical and Chemical Basics of Ma | | Lecture | 2 | 2 |
| Module Responsible | Prof. Jörg Weißmüller | | | |
| Admission Requirements | | | | |
| | Highschool-level physics, chemistry und mathematics | | | |
| Educational Objectives | After taking part successfully, students have reached the follow | ving learning results | | |
| Professional Competence | Arter taking part successionly, students have reached the follow | | | |
| Knowledge | The students have acquired a fundamental knowledge on a comprehensively. Fundamental knowledge here means specific phase transformations, corrosion and mechanical properties. T for materials and can identify relevant approaches for cha phenomena back to the underlying physical and chemical laws | cally the issues of ator he students know abo aracterizing specific p | nic structure, microstructor ut the key aspects of char | ure, phase diagrai acterization meth |
| Skills | The students are able to trace materials phenomena back to phenomena here refers to mechanical properties such as stree resistance, and to phase transformations such as solidification between processing conditions and the materials microstruct material's behavior. | ngth, ductility, and st | iffness, chemical properti nelting. The students can | es such as corros explain the relat |
| Personal Competence | | | | |
| Social Competence | - | | | |
| Autonomy | - | | | |
| | Independent Study Time 96, Study Time in Lecture 84 | | | |
| Credit points | | | | |
| - | | | | |
| | Written exam | | | |
| Examination duration and | | | | |
| examination duration and scale | 180 mm | | | |
| Assignment for the Following Curricula | General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S General Engineering Science (German program, 7 semester): S Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory Energy and Environmental Engineering: Core Qualification: Cor General Engineering Science (English program, 7 semester): S General Engineering Science (English program, 7 semester): S Mechanical Engineering: Core Qualification: Compulsory | pecialisation Biomedia pecialisation Energy a pecialisation Naval Ar pecialisation Naval Ar pecialisation Energy ar pecialisation Mechanic pecialisation Naval Arc pecialisation Biomedic pecialisation Naval Arc | cal Engineering: Compulso and Enviromental Engineer chitecture: Compulsory chitecture: Compulsory and Enviromental Engineerin al Engineering: Compulsory al Engineering: Compulsory | ry 'ing: Compulsory ng: Compulsory ry |
| | Mechatronics: Core Qualification: Compulsory Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Ele | ective Compulsory | | |

| Course L1085: Fundamentals | s of Materials Science I |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 P. Haasen: Physikalische Metallkunde. Springer 1994 |

| Course L0506: Fundamentals | of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Stefan Fritz 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 | Тур | | Hrs/wk | СР |
| Computer Engineering (L0321) | Lecture | | 3 | 4 |
| Computer Engineering (L0324) | Recitatio | on Section (small) | 1 | 2 |
| Module Responsible | Prof. Heiko Falk | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | | | | |
| | After taking part successfully, students have reached the following learning | ng results | | |
| Professional Competence | | an average. It covers th | ha lavara fran | |
| Knowledge | P This module deals with the foundations of the functionality of computing programming down to gates. The module includes the following topics: | ig systems. It covers th | ne layers from | the assembly-le |
| | Introduction | | | |
| | Combinational logic: Gates, Boolean algebra, Boolean functions, ha | - | binational netw | orks |
| | Sequential logic: Flip-flops, automata, systematic hardware design Technological foundations | | | |
| | Computer arithmetic: Integer addition, subtraction, multiplication a | and division | | |
| | Basics of computer architecture: Programming models, MIPS single | | elining | |
| | Memories: Memory hierarchies, SRAM, DRAM, caches | | | |
| | Input/output: I/O from the perspective of the CPU, principles of pas | sing data, point-to-poin | t connections, | busses |
| Skills | The students perceive computer systems from the architect's perspective | e. i.e., they identify the | internal structu | ure and the physi |
| | composition of computer systems. The students can analyze, how highly | | | |
| | collection of few and simple components. They are able to distinguish b | | | |
| | today's computing systems - from gates and circuits up to complete proc | essors. | | |
| | After successful completion of the module, the students are able to jud | dae the interdependent | ries between a | physical compu |
| | system and the software executed on it. In particular, they shall underst | | | |
| | on the hardware-centric abstraction layers from the assembly language | | | |
| | the impact that these low abstraction levels have on an entire system's p | erformance and to prop | ose feasible op | otions. |
| Personal Competence | | | | |
| | Students are able to solve similar problems alone or in a group and to pre | esent the results accord | inaly | |
| Social competence | students are usie to solve similar problems alone of ma group and to pre | sent the results accord | iligiy. | |
| Autonomy | Students are able to acquire new knowledge from specific literature and t | to associate this knowle | dge with other | classes. |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | | | | |
| Course achievement | Compulsory Bonus Form Description | | | |
| | Yes 10 % Excercises | | | |
| | Written exam | | | |
| Examination duration and scale | 90 minutes, contents of course and labs | | | |
| | General Engineering Science (German program, 7 semester): Specialisati | on Computer Science: (| ompulsory | |
| | General Engineering Science (German program, 7 semester): Specialisati | | | v |
| · · · · · · · · · · · · · · · · · · · | General Engineering Science (German program, 7 semester): Specialisati | | | , |
| | General Engineering Science (German program, 7 semester): Specialisati | on Electrical Engineerin | g: Compulsory | |
| | General Engineering Science (German program, 7 semester): Specialisati | on Biomedical Engineer | ing: Compulsor | У |
| | General Engineering Science (German program, 7 semester): Specialisati | on Energy and Envirom | ental Engineeri | ng: Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisati | on Process Engineering | : Compulsory | |
| | General Engineering Science (German program, 7 semester): Speci | alisation Mechanical E | Engineering, Fo | ocus Mechatron |
| | Compulsory General Engineering Science (German program, 7 semester): Speci- | alisation Mechanical E | ngineering, Fo | ocus Biomechani |
| | Compulsory | | 5 5, . | |
| | General Engineering Science (German program, 7 semester): Special | isation Mechanical Eng | gineering, Focu | ıs Aircraft Syste |
| | Engineering: Compulsory | | | |
| | General Engineering Science (German program, 7 semester): Spec | ialisation Mechanical | Engineering, | Focus Materials |
| | Engineering Sciences: Compulsory | ion Mochanical Enginee | ring Focus The | aratical Machani |
| | General Engineering Science (German program, 7 semester): Specialisati | on Mechanical Enginee | nng, rocus The | orerical Mechani |
| | Engineering: Compulsory | | erina Focus Pr | oduct Developm |
| | Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisal | tion Mechanical Engine | | ouuce Developin |
| | | tion Mechanical Engine | ening, rocus ri | |
| | General Engineering Science (German program, 7 semester): Specialisat | - | - | · |
| | General Engineering Science (German program, 7 semester): Specialisat and Production: Compulsory | isation Mechanical Eng | ineering, Focu | s Energy Syster |
| | General Engineering Science (German program, 7 semester): Specialisat and Production: Compulsory General Engineering Science (German program, 7 semester): Speciali Compulsory | isation Mechanical Eng | ineering, Focu | s Energy Syster |
| | General Engineering Science (German program, 7 semester): Specialisat and Production: Compulsory General Engineering Science (German program, 7 semester): Specialis Compulsory General Engineering Science (German program, 7 semester): Specialis | isation Mechanical Eng isation Mechanical Eng | ineering, Focu | s Energy Syster |
| | General Engineering Science (German program, 7 semester): Specialisat and Production: Compulsory General Engineering Science (German program, 7 semester): Speciali Compulsory General Engineering Science (German program, 7 semester): Speciali Compulsory | isation Mechanical Eng isation Mechanical Eng | ineering, Focu | s Energy Syster |
| | General Engineering Science (German program, 7 semester): Specialisat and Production: 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): Specialisati | isation Mechanical Eng isation Mechanical Eng | ineering, Focu | s Energy Syste |
| | General Engineering Science (German program, 7 semester): Specialisat and Production: Compulsory General Engineering Science (German program, 7 semester): Speciali Compulsory General Engineering Science (German program, 7 semester): Speciali Compulsory General Engineering Science (German program, 7 semester): Specialisati Computer Science: Core Qualification: Compulsory | isation Mechanical Eng isation Mechanical Eng | ineering, Focu | s Energy Syste |
| | General Engineering Science (German program, 7 semester): Specialisat and Production: 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): Specialis Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory General Engineering: Core Qualification: Specialisati General Engineering: Core Qualification: Specialisati | isation Mechanical Eng isation Mechanical Eng on Civil Engineering: Co | ineering, Focu ineering, Focu ompulsory g: Compulsory | s Energy Syste |
| | General Engineering Science (German program, 7 semester): Specialisat and Production: Compulsory General Engineering Science (German program, 7 semester): Speciali Compulsory General Engineering Science (German program, 7 semester): Speciali Compulsory General Engineering Science (German program, 7 semester): Specialisati Computer Science: Core Qualification: Compulsory Data Science: Core Qualification: Elective Compulsory Electrical Engineering: Core Qualification: Compulsory | isation Mechanical Eng isation Mechanical Eng on Civil Engineering: Co on Electrical Engineering on Civil Engineering: Cor | ineering, Focu ineering, Focu impulsory g: Compulsory npulsory | s Energy System |

| G | General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory |
|---|--|
| G | General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory |
| G | Seneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: |
| C | Compulsory |
| G | Seneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: |
| C | Compulsory |
| G | Seneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems |
| E | ingineering: Compulsory |
| G | Seneral Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering |
| S | sciences: Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: |
| C | Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development |
| a | and Production: Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical |
| E | Ingineering: Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory |
| C | Computational Science and Engineering: Core Qualification: Compulsory |
| Μ | Aechatronics: Core Qualification: Compulsory |
| Т | echnomathematics: Specialisation II. Informatics: Elective Compulsory |

| Course L0321: Computer Eng | jineering | | |
|----------------------------|---|--|--|
| Тур | ıre | | |
| Hrs/wk | | | |
| CP | 4 | | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | | |
| Lecturer | Prof. Heiko Falk | | |
| Language | DE/EN | | |
| 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 Eng | Course L0324: Computer Engineering | | |
|----------------------------|--|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 1 | | |
| СР | 2 | | |
| Workload in Hours | endent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Heiko Falk | | |
| Language | | | |
| Cycle | WiSe | | |
| Content | e interlocking course | | |
| Literature | See interlocking course | | |

| Module M0680: Fluid | Dynamics | | | |
|-----------------------------|--|-----------------------------------|-------------------|----------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Fluid Mechanics (L0454) | | Lecture | 3 | 4 |
| Fluid Mechanics (L0455) | | Recitation Section (large) | 2 | 2 |
| Module Responsible | Prof. Thomas Rung | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Sound knowledge of engineering mathematics, engineering me | echanics and thermodynamics. | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the follow | wing 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 mathematical models and are familiar with methods for the performance analysis and the prediciton of fluid engineering devices. | | | |
| 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 calculations for the fluid dynamic design of engineering devices on scientific level. | | | |
| Personal Competence | | | | |
| Social Competence | The students are able to discuss problems and jointly develop | solution strategies. | | |
| Autonomy | The students are able to develop solution strategies for comple | ex problems self-consistent and | crtically analyse | results. |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | Written exam | | | |
| Examination duration and | 180 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 semester): 9 | Specialisation Mechanical Engine | eering: Compulso | iry |
| Following Curricula | General Engineering Science (German program, 7 semester): S | | | |
| - | General Engineering Science (German program, 7 semester): S | Specialisation Naval Architecture | e: Compulsory | |
| | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering: Compulsory | | | |
| | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory | | | |
| | General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory | | | |
| | Computational Science and Engineering: Specialisation Engine | ering Sciences: Elective Compu | lsory | |
| | Mechanical Engineering: Core Qualification: Compulsory | | | |
| | Naval Architecture: Core Qualification: Compulsory | | | |
| | Technomathematics: Specialisation III. Engineering Science: El | ective Compulsory | | |

| Course L0454: Fluid Mechani | ics |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Thomas Rung |
| Language | DE/EN |
| Cycle | SoSe |
| Content | continuum physics definition of fluids, difference to solids/structures and material properties of fluids dimensional analysis and similitude fluid forces and fluid statics transport and conservation of mass, momentum & energy fluid kinematics technically relevant flow models for incompressible fluids control volume & stream tube analysis vortical flow models potential flows boundary layer flows different types of conservation equations and their realm (Navier-Stokes/Euler/Bernoulli equations) analytical solutions for Navier-Stokes systems Analysis of internal flows (channels, pipes, open channels) and external flows, fundamentals of wing aerodynamics turbulent flows fundamentals of gas dynamics (1D compressible flows) |
| Literature | the course primarily refers to / das Modul stütz sich bevorzugt auf : Munson, B.R.; Rothmayer, A.P.; Okiishi, T.H.; Huebsch, W.W.: Fundamentals of Fluid Mechanics, John Wiley & Sons. Spurk, J.; Aksel, N.: Strömungslehre, Springer. Schade, H.; Kunz, E., Kameier, F.; Paschereit, C.O.: Strömungslehere, De Gruyter. Herwig, H.: Strömungsmechanik, Springer. Herwig, H.: Strömungsmechanik von A-Z, Vieweg. |

| Course L0455: Fluid Mechani | ourse L0455: Fluid Mechanics | | | |
|-----------------------------|---|--|--|--|
| Тур | Typ Recitation Section (large) | | | |
| Hrs/wk | 2 | | | |
| СР | 2 | | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | | |
| Lecturer | Thomas Rung | | | |
| Language | DE/EN | | | |
| Cycle | SoSe | | | |
| Content | See interlocking course | | | |
| Literature | See interlocking course | | | |

| Courses | | | | | |
|---|--|--|-------------------|---------------------|--|
| Title | | Тур | Hrs/wk | СР | |
| | al Mechanics, Numerical Mechanics) (L1137) | Lecture | 3 | 3 | |
| | al Mechanics, Numerical Mechanics) (L1138) al Mechanics, Numerical Mechanics) (L1139) | Recitation Section (small) Recitation Section (large) | 2 1 | 2 1 | |
| | | Recitation Section (large) | T | T | |
| Module Responsible | | | | | |
| Admission Requirements | | | | | |
| | Mathematics I-III and Mechanics I-III | | | | |
| Knowledge | After teleing part successfully, students have reached t | | | | |
| Educational Objectives Professional Competence | After taking part successfully, students have reached t | le following learning results | | | |
| - | The students can | | | | |
| Knowledge | | | | | |
| | describe the axiomatic procedure used in mecha | nical contexts; | | | |
| | explain important steps in model design; | | | | |
| | present technical knowledge. | | | | |
| Skills | The students can | | | | |
| | | | | | |
| | explain the important elements of mathematication and their own problemes. | I / mechanical analysis and model for | mation, and appl | y it to the context | |
| | 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. | | | | |
| | • estimate the reach and boundaries of the metho | us and extend them to be applicable of | o wider problem | 5005. | |
| | | | | | |
| Personal Competence | | | | | |
| | The students can work in groups and support each oth | er to overcome difficulties | | | |
| boelar competence | | | | | |
| Autonomy | Students are capable of determining their own strengt | is and weaknesses and to organize the | ir time and learn | ing based on those | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 | | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and | 120 min | | | | |
| scale | | | | | |
| Assignment for the | General Engineering Science (German program, 7 sem | ester): Specialisation Mechanical Engin | eering: Compuls | ory | |
| Following Curricula | General Engineering Science (German program, 7 sem | ester): Specialisation Biomedical Engin | eering: Compulso | ory | |
| | General Engineering Science (German program, 7 sem | ester): Specialisation Naval Architectur | e: Compulsory | | |
| | Energy Systems: Technical Complementary Course Con | e Studies: Elective Compulsory | | | |
| | General Engineering Science (English program, 7 seme | ster): Specialisation Mechanical Engine | ering: Compulso | ry | |
| | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory | | | | |
| | General Engineering Science (English program, 7 seme | ster): Specialisation Biomedical Engine | ering: Compulso | ry | |
| | Mechanical Engineering: Core Qualification: Compulsory | | | | |
| | Mechatronics: Core Qualification: Compulsory | | | | |
| | Naval Architecture: Core Qualification: Compulsory | | | | |
| | Technomathematics: Specialisation III. Engineering Sci | ence: Elective Compulsory | | | |
| | Theoretical Mechanical Engineering: Technical Comple | nentary Course Core Studies: Elective | Compulsory | | |
| | | | | | |
| Course L1137: Mechanics IV | (Oscillations, Analytical Mechanics, Numerical Me | chanics) | | | |
| Тур | Lecture | | | | |
| Hrs/wk | | | | | |
| СР | | | | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | | | |
| Lecturer | Prof. Robert Seifried | | | | |
| | | | | | |

| Lecturer | Prof. Robert Seifried |
|------------|--|
| Language | DE |
| Cycle | SoSe |
| Content | |
| | Elements of vibration theory Vibration of Multi-degree of freedom systems Analytical Mechanics 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 | (Oscillations, Analytical Mechanics, Numerical Mechanics) |
|----------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| CP | 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 | (Oscillations, Analytical Mechanics, Numerical Mechanics) |
| 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

See interlocking course

Literature See interlocking course

Content

| Courses | |
|---|---|
| Title | Typ Hrs/wk CP |
| Introduction to Anatomy (L0384) | Lecture 2 3 |
| Module Responsible | Prof. Udo Schumacher |
| Admission Requirements | None |
| Recommended Previous | None |
| Knowledge | |
| Educational Objectives | After taking part successfully, students have reached the following learning results |
| Professional Competence | |
| Knowledge | The students can describe basal structures and functions of internal organs and the musculoskeletal system. |
| | The students can describe the basic macroscopy and microscopy of those systems. |
| Skills | The students can recognize the relationship between given anatomical facts and the development of some common diseases; th |
| | 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 biomedical research and medicine on a professional level. |
| Autonomy | The students are able to access anatomical knowledge by themselves, can participate in conversations on the topic and acqui |
| | the relevant knowledge themselves. |
| Mendels and In Harris | la desendent Chade Time C. Chade Time in Lecture 20 |
| | Independent Study Time 62, Study Time in Lecture 28 |
| Credit points Course achievement | |
| | Written exam |
| Examination Examination duration and | |
| | 90 minutes |
| | |
| scale | Constal Engineering Science (Corman program, 7 constant), Specialization Biomedical Engineering, Computerny |
| Assignment for the | General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory |
| Assignment for the | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan |
| Assignment for the | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory |
| Assignment for the | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory Data Science: Specialisation Medicine: Compulsory |
| Assignment for the | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory |
| Assignment for the | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory |
| Assignment for the | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory |
| Assignment for the | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan |
| Assignment for the | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory |
| Assignment for the | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering; Compulsory General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering; Compulsory |
| Assignment for the | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan 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 Biomedical Engineering: Compulsory General Engineering: Specialisation Biomechanics: Compulsory Mechanical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory |
| Assignment for the | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan 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 Biomedical Engineering: Compulsory General Engineering: Specialisation Biomechanics: Compulsory Mechanical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory |
| Assignment for the | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani 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 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 |
| Assignment for the | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani Compulsory Data Science: Specialisation Medicine: Compulsory Electrical Engineering: Specialisation Medical Technology: Elective Compulsory Engineering Science: Specialisation Biomedical Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechani 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 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 |

| rse L0384: Introduction t | to Anatomy | | |
|---------------------------|---|--|--|
| Тур | ecture | | |
| Hrs/wk | | | |
| СР | | | |
| | dependent Study Time 62, Study Time in Lecture 28 | | |
| | Prof. Tobias Lange | | |
| Language | | | |
| | SoSe General Anatomy | | |
| Content | 1 st week: The Eucaryote Cell | | |
| | 2 rd week: The Tissues 3 rd week: Cell Cycle, Basics in Development | | |
| | 4 th week: Musculoskeletal System | | |
| | 5 th week: Cardiovascular System | | |
| | 6 th week: Respiratory System | | |
| | week: Genito-urinary System | | |
| | 8 th week: Immune system 9 th week: Digestive System I | | |
| | | | |
| | 10 th week: Digestive System II | | |
| | 11 th week: Endocrine System | | |
| | 12 th week: Nervous System | | |
| | 13 th week: Exam | | |
| Literature | Adolf Faller/Michael Schünke, Der Körper des Menschen, 17. Auflage, Thieme Verlag Stuttgart, 2016 | | |

| Courses | | | | | |
|-----------------------------------|--|--|-----------------------------|-------------------------------|--|
| Fitle | | Тур | Hrs/wk | СР | |
| ntroduction to Radiology and Radi | ation Therapy (L0383) | Lecture | 2 | 3 | |
| Module Responsible | Prof. Ulrich Carl | | | | |
| Admission Requirements | | | | | |
| Recommended Previous Knowledge | None | | | | |
| | After taking part successfully, studen | ts have reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | | | | | |
| | The students can distinguish different | t types of currently used equipment with respect | to its use in radiation the | erapy. | |
| | The students can explain treatment p | plans used in radiation therapy in interdisciplinary | y contexts (e.g. surgery, | internal medicine). | |
| | The students can describe the pa | tients' passage from their initial admittanc | e through to follow-up | o care. | |
| | Diagnostics | | | | |
| | The students can illustrate the techn | nical base concepts of projection radiography, ir | ncluding angiography an | d mammography | |
| | well as sectional imaging techniques | | iciduling anglography and | a manniography, s | |
| | The students can explain the diagnost techniques. | stic as well as therapeutic use of imaging techni | iques, as well as the tech | nical basis for the | |
| | The students can choose the right tre | eatment method depending on the patient's clinic | cal history and needs. | | |
| | The student can explain the influence | e of technical errors on the imaging techniques. | | | |
| | | | | | |
| | The student can draw the right conclusions based on the images' diagnostic findings or the error protocol. | | | | |
| Skills | Therapy The students can distinguish curative and palliative situations and motivate why they came to that conclusion. | | | | |
| | The students can develop adequate therapy concepts and relate it to the radiation biological aspects. | | | | |
| | The students can use the therapeutic principle (effects vs adverse effects) | | | | |
| | The students can distinguish different kinds of radiation, can choose the best one depending on the situation (location of the | | | | |
| | tumor) and choose the energy needed in that situation (irradiation planning). | | | | |
| | The student can assess what an inc groups, self-help groups, social servic | dividual psychosocial service should look like (ces, psycho-oncology). | e.g. follow-up treatment | :, sports, social he | |
| | Diagnostics | | | | |
| | The students can suggest solutions for | or repairs of imaging instrumentation after having | g done error analyses. | | |
| | The students can classify results of | imaging techniques according to different grou | ups of diseases based or | n their knowledge | |
| | anatomy, pathology and pathophysio | | | | |
| Personal Competence | | | | | |
| Social Competence | | social situation of tumor patients and interact wit ecial, often fear-dominated behavior of sick pe | | | |
| | measures and can meet them approp | | opic cuused by diagno. | stie und therapeu | |
| Autonomy | The students can apply their new kno | wledge and skills to a concrete therapy case. | | | |
| , laconomy | The students can introduce younger s | | | | |
| | The students are able to access anat | tomical knowledge by themselves, can participa | ate competently in conve | rsations on the tor | |
| | and acquire the relevant knowledge t | | | | |
| Workload in Hours | Independent Study Time 62, Study Ti | me in Lecture 28 | | | |
| Credit points | | | | | |
| Course achievement | None | | | | |
| Examination | | | | | |
| Examination duration and scale | 90 minutes | | | | |
| | General Engineering Science (Germar | n program, 7 semester): Specialisation Biomedica | al Engineering: Compulso | ory | |
| Following Curricula | General Engineering Science (Gern | nan program, 7 semester): Specialisation Me | chanical Engineering, F | [;] ocus Biomechanic | |
| | Compulsory | . Computer r | | | |
| | Data Science: Specialisation Medicine Electrical Engineering: Specialisation | e: Compulsory Medical Technology: Elective Compulsory | | | |
| | Engineering Science: Specialisation B | | | | |
| | | ish program, 7 semester): Specialisation Me | chanical Engineering, F | ocus Biomechanic | |
| | Compulsory General Engineering Science (English | program, 7 semester): Specialisation Biomedica | al Engineering: Compulse | rv | |
| | | program, 7 semester): Specialisation Biomedica | | | |
| | - | | | | |
| | Mechanical Engineering: Specialisatio | on Biomechanics: 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: Specialisation III. Engineering Science: Elective Compulsory

| Course L0383: Introduction t | to Radiology and Radiation Therapy |
|------------------------------|---|
| Тур | Lecture |
| Hrs/wk | |
| СР | |
| | 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 of medical imaging, interventional radiology and radiation therapy/radiation oncology. It is assumed, that students in the beginning of the course have heard the word "X-ray" at best. It will be distinguished between the two arms of diagnostic (Prof. Dr. med. Thomas Vestring) and therapeutic (Prof. Dr. med. Ulrich Carl) use of X-rays. Both arms depend on special big units, which determine a predefined sequence in their respective departments |
| 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 – erschienen 08.12.2009 |
| | ISBN: 978-3-437-47501-6 |
| | "Taschenatlas der Physiologie" von S. Silbernagel und A. Despopoulus- |
| | 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 | | Тур | Hrs/wk | СР |
| Numerical Mathematics I (L0417) | | Lecture | 2 | 3 |
| Numerical Mathematics I (L0418) | | Recitation Section (small) | 2 | 3 |
| Module Responsible | Prof. Sabine Le Borne | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mathematik I + II for Engineering Students (german | or english) or Analysis & Linear Al | aebra I + II for Te | chnomathematic |
| Knowledge | basic MATLAB/Python knowledge | | | |
| | | | | |
| | After taking part successfully, students have reached the for | bllowing learning results | | |
| Professional Competence | | | | |
| Knowleage | Students are able to | | | |
| | name numerical methods for interpolation, integration | on, least squares problems, eigenv | value problems, r | onlinear root fin |
| | problems and to explain their core ideas, | | | |
| | repeat convergence statements for the numerical me | | | |
| | explain aspects for the practical execution of numeri | cal methods with respect to comp | utational and sto | rage complexitx. |
| | | | | |
| | | | | |
| Skills | Students are able to | | | |
| | implement, apply and compare numerical methods up | ising MATLAB/Python, | | |
| | justify the convergence behaviour of numerical methods | nods with respect to the problem a | nd solution algori | thm, |
| | select and execute a suitable solution approach for a | given problem. | | |
| Personal Competence | | | | |
| • | Students are able to | | | |
| boelar competence | | | | |
| | work together in heterogeneously composed teams | (i.e., teams from different study p | rograms and bac | kground knowled |
| | explain theoretical foundations and support each oth | ner with practical aspects regarding | g the implementa | tion of algorithm |
| Autonomy | Students are capable | | | |
| | | | | |
| | to assess whether the supporting theoretical and pra | | individually or in | i a team, |
| | to assess their individual progess and, if necessary, t | to ask questions and seek help. | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 minutes | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 semester | r): Specialisation Computer Science | e: Compulsory | |
| Following Curricula | General Engineering Science (German program, 7 ser | mester): Specialisation Mechanic | al Engineering, | Focus Material |
| | Engineering Sciences: Compulsory | | | |
| | General Engineering Science (German program, 7 semester | | | |
| | General Engineering Science (German program, 7 sem | lester): Specialisation Mechanica | I Engineering, F | ocus Biomecha |
| | Compulsory General Engineering Science (German program, 7 semeste | r): Specialisation Mechanical Engi | peering Focus Th | enetical Mecha |
| | Engineering: Compulsory | ry. specialisation mechanical Engli | leening, rocus m | leoretical meena |
| | General Engineering Science (German program, 7 seme | ster): Specialisation Mechanical | Engineerina. Foc | us Aircraft Syst |
| | Engineering: Elective Compulsory | | 3, 00 | |
| | General Engineering Science (German program, 7 semeste | r): Specialisation Mechanical Engi | neering, Focus M | echatronics: Elec |
| | Compulsory | . 5 | - | |
| | General Engineering Science (German program, 7 seme | ster): Specialisation Mechanical I | Engineering, Foc | us Energy Syste |
| | | | | |
| | Elective Compulsory | | | |
| | | ess Engineering: Elective Compulse | ory | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat | ics: Elective Compulsory | | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engir | ics: Elective Compulsory | | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engin Data Science: Core Qualification: Compulsory | ics: Elective Compulsory neering Science: Elective Compulso | | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engir Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls | ics: Elective Compulsory neering Science: Elective Compulso | | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engir Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory | ics: Elective Compulsory neering Science: Elective Compulso | | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engir Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory | ics: Elective Compulsory neering Science: Elective Compulso ory | | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engin Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester) | ics: Elective Compulsory neering Science: Elective Compulso ory): Core Qualification: Compulsory | bry | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engir Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester) General Engineering Science (English program, 7 semester) | ics: Elective Compulsory neering Science: Elective Compulso ory): Core Qualification: Compulsory): Specialisation Computer Science | ry : Compulsory | OCUS Riomacha |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engin Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester) General Engineering Science (English program, 7 semester) | ics: Elective Compulsory neering Science: Elective Compulso ory): Core Qualification: Compulsory): Specialisation Computer Science | ry : Compulsory | ocus Biomecha |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engin Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester) General Engineering Science (English program, 7 sem Compulsory | ics: Elective Compulsory neering Science: Elective Compulso ory): Core Qualification: Compulsory): Specialisation Computer Science ester): Specialisation Mechanica | ory : Compulsory I Engineering, F | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engin Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester, General Engineering Science (English program, 7 semester, Compulsory General Engineering Science (English program, 7 semester, | ics: Elective Compulsory neering Science: Elective Compulso ory): Core Qualification: Compulsory): Specialisation Computer Science ester): Specialisation Mechanica | ory : Compulsory I Engineering, F | |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engin Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester) General Engineering Science (English program, 7 sem Compulsory | ics: Elective Compulsory neering Science: Elective Compulsor ory): Core Qualification: Compulsory): Specialisation Computer Science ester): Specialisation Mechanical): Specialisation Mechanical Engine | ory : Compulsory I Engineering, F eering, Focus Mat | erials in Enginee |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engin Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester, General Engineering Science (English program, 7 semester, Sciences: Compulsory | ics: Elective Compulsory neering Science: Elective Compulsor ory): Core Qualification: Compulsory): Specialisation Computer Science ester): Specialisation Mechanical): Specialisation Mechanical Engine | ory : Compulsory I Engineering, F eering, Focus Mat | erials in Enginee |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engin Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester, General Engineering Science (English program, 7 semester, General Engineering Science (English program, 7 semester, General Engineering Science (English program, 7 semester, Sciences: Compulsory General Engineering Science (English program, 7 semester, Sciences: Compulsory General Engineering Science (English program, 7 semester, Sciences: Compulsory | ics: Elective Compulsory neering Science: Elective Compulso ory): Core Qualification: Compulsory): Specialisation Computer Science ester): Specialisation Mechanical): Specialisation Mechanical Engin | : Compulsory I Engineering, F eering, Focus Mat eeering, Focus Th | eerials in Enginee eoretical Mecha |
| | Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioproce Computer Science: Specialisation Computational Mathemat Computer Science: Specialisation II. Mathematics and Engin Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Elective Compuls Engineering Science: Core Qualification: Compulsory Engineering Science: Core Qualification: Compulsory General Engineering Science (English program, 7 semester) General Engineering Science (English program, 7 semester) Sciences: Compulsory General Engineering Science (English program, 7 semester) Sciences: Compulsory | ics: Elective Compulsory neering Science: Elective Compulso ory): Core Qualification: Compulsory): Specialisation Computer Science ester): Specialisation Mechanical): Specialisation Mechanical Engine r): Specialisation Mechanical Engine | : Compulsory I Engineering, F eering, Focus Mat eering, Focus Th eering: Compulso | erials in Enginee eoretical Mecha Y |

Computational Science and Engineering: Core Qualification: Compulsory

Mechanical Engineering: Specialisation Theoretical Mechanical Engineering: Compulsory

Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory

Mechanical Engineering: Specialisation Mechatronics: Elective Compulsory

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

Process Engineering: Specialisation Process Engineering: Elective Compulsory

| Course L0417: Numerical Ma | thematics I | | | | | |
|----------------------------|--|--|--|--|--|--|
| Тур | Lecture | | | | | |
| Hrs/wk | 2 | | | | | |
| CP | | | | | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | | | | |
| Lecturer | Prof. Sabine Le Borne | | | | | |
| Language | EN | | | | | |
| Cycle | WiSe | | | | | |
| Content | Finite precision arithmetic, error analysis, conditioning and stability Linear systems of equations: LU and Cholesky factorization, condition Interpolation: polynomial, spline and trigonometric interpolation Nonlinear equations: fixed point iteration, root finding algorithms, Newton's method Linear and nonlinear least squares problems: normal equations, Gram Schmidt and Householder orthogonalization, singular value decomposition, regularizatio, Gauss-Newton and Levenberg-Marquardt methods Eigenvalue problems: power iteration, inverse iteration, QR algorithm Numerical differentiation Numerical integration: Newton-Cotes rules, error estimates, Gauss quadrature, adaptive quadrature | | | | | |
| Literature | Gander/Gander/Kwok: Scientific Computing: An introduction using Maple and MATLAB, Springer (2014) Stoer/Bulirsch: Numerische Mathematik 1, Springer Dahmen, Reusken: Numerik f ür Ingenieure und Naturwissenschaftler, Springer | | | | | |

| Course L0418: Numerical Ma | thematics I |
|----------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Sabine Le Borne, Dr. Jens-Peter Zemke |
| Language | EN |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Courses | | | | | | |
|-----------------------------|---|---|-------------------|--------------------|--|--|
| Title | | Тур | Hrs/wk | СР | | |
| Heat Transfer (L0458) | | Lecture | 3 | 4 | | |
| Heat Transfer (L0459) | | Recitation Section (large) | 2 | 2 | | |
| Module Responsible | Dr. Andreas Moschallski | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Technical Thermodynamics I, II and Fluid Dynamics | | | | | |
| Knowledge | | | | | | |
| , | After taking part successfully, students have reached th | e following learning results | | | | |
| Professional Competence | | | | | | |
| Knowledge | The students are able to | | | | | |
| | - describe the different physical mechanism of Heat Tra | nsfer, | | | | |
| | - explain the technical terms, | | | | | |
| | - to analyse comlex heat transfer processes in a critical | way. | | | | |
| Skills | The students are able to | | | | | |
| | - understand the physics of Heat Transfer, | | | | | |
| | - calculate and evaluate complex Heat Transfer processes, | | | | | |
| | - solve excersises self-consistent and in small groups. | | | | | |
| Personal Competence | | | | | | |
| | The students are able to discuss in small groups and de | velop an approach. | | | | |
| Autonomy | The students are able to develop a complex problem se | If-consistent and analyse the results i | n a critical way. | A qualified exchar | | |
| | with other students is given. | ····· | · · · · · , | 1 | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | | | |
| Credit points | 6 | | | | | |
| Course achievement | None | | | | | |
| Examination | Written exam | | | | | |
| Examination duration and | 120 min | | | | | |
| scale | | | | | | |
| Assignment for the | General Engineering Science (German program, 7 se | mester): Specialisation Mechanical | Engineering, Foc | us Energy Syster | | |
| Following Curricula | Compulsory | | | | | |
| | General Engineering Science (German program, 7 seme | ster): Specialisation Biomedical Engin | eering: Compulso | ory | | |
| | General Engineering Science (German program, 7 seme | ster): Specialisation Mechanical Engin | neering, Focus Th | neoretical Mechani | | |
| | Engineering: Compulsory | | | | | |
| | Energy Systems: Technical Complementary Course Core | Studies: Elective Compulsory | | | | |
| | General Engineering Science (English program, 7 se | mester): Specialisation Mechanical I | Engineering, Foc | us Energy Syster | | |
| | Compulsory | | - | | | |
| | General Engineering Science (English program, 7 semes | ter): Specialisation Biomedical Engine | ering: Compulso | ry | | |
| | Mechanical Engineering: Specialisation Energy Systems | | | | | |
| | Mechanical Engineering: Specialisation Theoretical Mech | | orv | | | |

| Course L0458: Heat Transfer | |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 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 (steady and unsteady), Convective Heat Transfer (natural convection, forced convection), |
| | Two-phase Heat Transfer (evaporation, condensation), Thermal Radiation, Heat Transfer on a thermodynamic view, |
| | thermotechnical devices, measures of temperature and heat flux |
| | |
| | |
| Literature | - Herwig, H.; Moschallski, A.: Wärmeübertragung, 4. Auflage, Springer Vieweg Verlag, Wiesbaden, 2019 |
| | - 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 | urse 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 | | | | ту | /p | | rs/wk | СР |
| Practical Course: Measurement and Control Systems (L1119) | | | | actical Course | 2 | | 2 | |
| Measurement Technology for Mechanical Engineering (L1116) Measurement Technology for Mechanical Engineering (L1118) | | | | | cture | 2 | | 3 |
| | | 18) | | Re | citation Section (larg | e) 1 | | 1 |
| Module Responsible | | | | | | | | |
| Admission Requirements | | | | | | | | |
| Recommended Previous | Basic knowledge of p | hysics, chemist | try and electrica | al engineering | | | | |
| Knowledge | | | | | | | | |
| Educational Objectives | After taking part succ | cessfully, stude | nts have reache | ed the following | learning results | | | |
| Professional Competence | | | | | | | | |
| Knowledge | Students are able to Calibration, Static ar | | | | | hnology (Qua | ntities and | l Units, Uncerta |
| | They can outline the | most importa | nt measuring m | nethods for diffe | rent kinds of quant | ities to be m | aesured (E | Electrical Quant |
| | Temperature, mecha | | | | | | | |
| | They can describe im | portant metho | ds of chemical A | Analysis (Gas Se | nsors, Spectroscopy | , Gas Chroma | itography) | |
| | | | | | | | | |
| Skills | Students can select s | uitable measur | ing methods to | given problems | and can use referin | g measureme | ent devices | in practice. |
| | The students are able | e to orally expl | ain issues in the | e subject area c | f measurement tec | hnology and s | solution ap | proaches as w |
| | place the issues into | the right conte | xt and application | on area. | | | | |
| Personal Competence | | | | | | | | |
| • | Students can arrive a | t work results i | n arouns and de | ocument them in | a common report | | | |
| , | | | | | | | | |
| | | | | | | | | |
| Autonomy | Students are able to | familiarize ther | nselves with new | | | | | |
| | | | | w measurement | | | | |
| Workload in Hours | Independent Study T | | | w measurement | | | | |
| Workload in Hours Credit points | Independent Study T | | Time in Lecture | w measurement e 70 | | | | |
| Workload in Hours | Independent Study T | ime 110, Study Form | Time in Lecture | w measurement | | | | |
| Workload in Hours Credit points | Independent Study T 6 Compulsory Bonus | ime 110, Study Form | Time in Lecture | w measurement e 70 | | | | |
| Workload in Hours Credit points Course achievement | Independent Study T 6 Compulsory Bonus Yes None | ime 110, Study Form Subject th practical wor | Time in Lecture eoretical and k | w measurement e 70 | | | | |
| Workload in Hours Credit points Course achievement Examination | Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an | ime 110, Study Form Subject th practical wor | Time in Lecture eoretical and k | w measurement e 70 | | | | |
| Workload in Hours Credit points Course achievement Examination | Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an | ime 110, Study Form Subject th practical wor | Time in Lecture eoretical and k | w measurement e 70 | | | | |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale | Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes | Form Subject th practical wor | Time in Lecture eoretical and k rk | w measurement 9 70 Description | technologies. | Engineering | Compulso | |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering | Form Subject th practical wor nd practical wo | Time in Lecture eoretical and k rk an program, 7 so | w measurement 2 70 Description emester): Specia | technologies. | | | |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering | Form Subject th practical wor nd practical wo Science (Germa Science (Germa | Time in Lecture eoretical and k rk an program, 7 so an program, 7 so | w measurement 9 70 Description emester): Specia emester): Specia | technologies. | Engineering: | Compulso | ry |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering General Engineering | Form Subject th practical wor nd practical wo Science (Germa Science (Germa Science (Germa | Time in Lecture eoretical and k rk an program, 7 so an program, 7 so an program, 7 so | w measurement e 70 Description emester): Specia emester): Specia emester): Specia | technologies. | Engineering: | Compulso | ry |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering General Engineering Digital Mechanical En | Form Subject th practical wor nd practical wo Science (Germa Science (Germa Science (Germa Science (Germa | Time in Lecture eoretical and k rk an program, 7 so an program, 7 so an program, 7 so an program, 7 so an program, 7 so | w measurement | technologies. | Engineering: | Compulso | ry |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm | Form Subject th practical wor nd practical wo Science (Germa Science (Germa Science (Germa Science (Germa | Time in Lecture eoretical and k rk an program, 7 sc an pr | w measurement 2 70 Description emester): Speci emester): Speci emester): Speci compulsory ication: Compuls | technologies. | Engineering: | Compulso | ry |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: | Form Subject th practical wor nd practical wo Science (Germa Science (Germa Science (Germa Science (Germa Science (Germa Science (Germa Specialisation | Time in Lecture eoretical and k rk an program, 7 sc an pr | w measurement | technologies. | Engineering: | Compulso | ry |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: | Form Subject th practical wor nd practical wor Science (Germa Science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation | Time in Lecture eoretical and k rk an program, 7 sc an pr | w measurement 2 70 Description emester): Speci emester): Speci emester): Speci compulsory ication: Compuls compulsory ineering: Compu | technologies. | Engineering: | Compulso | ry |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: | Form Subject th practical wor nd practical wor Science (Germa Science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation Specialisation | Time in Lecture eoretical and k rk an program, 7 si an program, 7 si an program, 7 si an program, 7 si an program, 7 si a Qualification: 0 ing: Core Qualifi Mechatronics: C Mechanical Eng Biomedical Engi | w measurement 2 70 Description emester): Speci emester): Speci emester): Speci compulsory ication: Compuls Compulsory ineering: Compu ineering: Electiv | technologies. | Engineering: I Enviromenta | Compulso al Engineer | ry ing: Compulsor |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering | Form Subject th practical wor nd practical wor Science (Germa Science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation Specialisation Science (Englis | Time in Lecture eoretical and k rk an program, 7 si an program, 7 si an program, 7 si an program, 7 si e Qualification: (ing: Core Qualifi Mechatronics: C Mechanical Eng Biomedical Engi h program, 7 se | w measurement 2 70 Description emester): Speci emester): Speci emester): Speci compulsory ication: Compuls Compulsory ineering: Compu ineering: Electiv emester): Specia | technologies. alisation Mechanica alisation Biomedical alisation Energy and sory e Compulsory lisoty and | Engineering: Enviromenta | Compulso al Engineer Engineerin | ry ing: Compulsor ng: Compulsory |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering | Form Subject th practical wor nd practical wor difference (Germa Science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation Specialisation Science (Englis Science (Englis | Time in Lecture eoretical and k rk an program, 7 si an program, 7 si an program, 7 si a Qualification: (ing: Core Qualifi Mechatronics: C Mechanical Eng Biomedical Eng h program, 7 se h program, 7 se | w measurement 2 70 Description Description emester): Specia emester): Specia emester): Specia Compulsory ication: Compuls Compulsory ineering: Compu ineering: Electiv emester): Specia emester): Specia | technologies. alisation Mechanica alisation Biomedical alisation Energy and sory e Compulsory lisotion Energy and lisation Energy and lisation Mechanical | Engineering: Enviromenta Enviromental Engineering: | Compulso al Engineer Engineerin Compulsor | ry ing: Compulsor ng: Compulsory Y |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering General Engineering General Engineering | Form Subject th practical wor nd practical wor difference (Germa Science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis | Time in Lecture eoretical and k rk an program, 7 si an program, 7 si an program, 7 si a Qualification: (ing: Core Qualifi Mechatronics: C Mechanical Eng Biomedical Eng h program, 7 se h program, 7 se | w measurement 2 70 Description Description emester): Specia emester): Specia compulsory ication: Compuls Compulsory ineering: Compu ineering: Electiv :mester): Specia :mester): Specia :mester): Specia | technologies. alisation Mechanica alisation Biomedical alisation Energy and sory e Compulsory lisotion Energy and lisation Mechanical lisation Biomedical | Engineering: I Enviromental Enviromental Engineering: Engineering: | Compulso Il Engineerin Engineerin Compulsor Compulsor | ry ing: Compulsor ng: Compulsory Y |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering General Engineering General Engineering General Engineering | Form Subject th practical wor nd practical wor nd practical wor Science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis Science (Englis | Time in Lecture eoretical and k rk an program, 7 si an program, 7 si an program, 7 si a program, 7 si e Qualification: 0 ing: Core Qualifi Mechatronics: C Mechanical Eng Biomedical Eng h program, 7 si h program, 7 si h program, 7 si h program, 7 si | w measurement 2 70 Description Description emester): Specia emester): Specia compulsory ication: Compuls compulsory ineering: Electiv emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia | technologies. alisation Mechanica alisation Biomedical alisation Energy and sory e Compulsory lisotion Energy and lisation Mechanical lisation Biomedical lisation Mechatronica | Engineering: Enviromental Engineering: Engineering: S:: Compulsor | Compulso I Engineeri Compulsor Compulsor Y | ry ing: Compulsor ng: Compulsory y y |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering | Form Subject th practical wor nd practical wor nd practical wor Science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis Science (Englis Science (Englis | Time in Lecture eoretical and k rk an program, 7 si an program, 7 si an program, 7 si e Qualification: 0 ing: Core Qualifi Mechatronics: C Mechanical Eng Biomedical Eng h program, 7 si h program, 7 si | w measurement 2 70 Description Description demester): Specia emester): Specia emester): Specia compulsory incering: Electiv emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia | technologies. alisation Mechanica alisation Biomedical alisation Energy and sory e Compulsory lisotion Energy and lisation Mechanical lisation Biomedical lisation Mechatronical lisation Mechanical | Engineering: Enviromental Engineering: Engineering: S: Compulsor Engineering: | Compulso al Engineerin Compulsor Compulsor y Compulsor y | ry ing: Compulsor ng: Compulsory y y y |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering General Engineering | Form Subject th practical wor nd practical wor nd practical wor Science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis Science (Englis Science (Englis Science (Englis Science (Englis | Time in Lecture eoretical and k rk an program, 7 si an program, 7 si an program, 7 si a Qualification: 0 ing: Core Qualifi Mechatronics: C Mechanical Eng biomedical Eng h program, 7 se h program, 7 se | w measurement 2 70 Description Description emester): Specia emester): Specia emester): Specia compulsory incering: Compul- compulsory incering: Compul- incering: Compul- incering: Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia | technologies. alisation Mechanica alisation Biomedical alisation Energy and isory e Compulsory lisotion Energy and lisation Mechanical lisation Mechanical lisation Mechanical lisation Mechanical lisation Mechanical lisation Biomedical | Engineering: Enviromental Engineering: Engineering: Compulsor Engineering: Engineering: | Compulso al Engineerin Compulsor Compulsor y Compulsor y | ry ing: Compulsor ng: Compulsory y y y |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering | Form Subject th practical wor and practical wor and practical wor Science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis Science (Englis Science (Englis Science (Englis Science (Englis Science (Englis Science (Englis | Time in Lecture eoretical and k rk an program, 7 si an program, 7 si an program, 7 si e Qualification: 0 ing: Core Qualifi Mechatronics: C Mechanical Eng h program, 7 si h program, 7 si | w measurement 2 70 Description Description emester): Specia emester): Specia emester): Specia compulsory incering: Compul- compulsory incering: Compul- compulsory incering: Compul- incering: Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia mester): Specia mester): Specia mester): Specia | technologies. alisation Mechanica alisation Biomedical alisation Energy and isory e Compulsory lisotion Energy and lisation Mechanical lisation Mechanical lisation Mechanical lisation Mechanical lisation Mechanical lisation Biomedical | Engineering: Enviromental Engineering: Engineering: Compulsor Engineering: Engineering: | Compulso al Engineerin Compulsor Compulsor y Compulsor y | ry ing: Compulsor ng: Compulsory y y y |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering Contral Engineering Contral Engineering Contral Engineering | Form Subject th practical wor and practical wor and practical wor Science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis | Time in Lecture eoretical and k rk an program, 7 si an program, 7 si an program, 7 si an program, 7 si e Qualification: 0 ing: Core Qualifi Mechatronics: C Mechanical Eng Biomedical Eng Biomedical Eng h program, 7 si h program, 7 si | w measurement 2 70 Description Description emester): Specia emester): Specia emester): Specia compulsory incering: Compul- compulsory incering: Compul- compulsory incering: Compul- incering: Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia emester): Specia mester): Specia mester): Specia mester): Specia | technologies. alisation Mechanica alisation Biomedical alisation Energy and isory e Compulsory lisotion Energy and lisation Mechanical lisation Mechanical lisation Mechanical lisation Mechanical lisation Mechanical lisation Biomedical | Engineering: Enviromental Engineering: Engineering: Compulsor Engineering: Engineering: | Compulso al Engineerin Compulsor Compulsor y Compulsor y | ry ing: Compulsor ng: Compulsory y y y |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study T 6 Compulsory Bonus Yes None Subject theoretical an 105 minutes General Engineering General Engineering Digital Mechanical En Energy and Environm Engineering Science: Engineering Science: Engineering Science: General Engineering General Engineering | Form Subject th practical wor and practical wor and practical wor science (Germa Science (Germa Science (Germa Science (Germa Specialisation Specialisation Specialisation Specialisation Science (Englis Science (Englis | Time in Lecture eoretical and k rk an program, 7 si an program, 7 si an program, 7 si an program, 7 si e Qualification: 0 ing: Core Qualifi Mechatronics: C Mechanical Eng Biomedical Eng Biomedical Eng h program, 7 si h pro | w measurement 2 70 Description Description Description demester): Specia emester): Specia compulsory incering: Compul- compulsory incering: Electiv emester): Specia emester): Specia | technologies. alisation Mechanica alisation Biomedical alisation Energy and isory e Compulsory lisation Energy and lisation Energy and lisation Mechanical lisation Mechanical lisation Mechanical lisation Biomedical rocesses: Elective C | Engineering: Enviromental Engineering: Engineering: S: Compulsor Engineering: Engineering: Engineering: Compulsory | Compulso al Engineeri Compulsor Compulsor Y Compulsor Elective Co | ry ing: Compulsor ng: Compulsory y y y mpulsory |

| | rse: Measurement and Control Systems |
|-------------------|---|
| Тур | Practical Course |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Thorsten Kern |
| Language | DE |
| Cycle | WiSe/SoSe |
| Content | Experiment 1: Emission and immission measurement of gaseous pollutants: different technologies to determine different gaseo pollutants in automotive exhaust are used. |
| | Experiment 2: Simulation and measurement of asynchrone engine and rotary pump: the dynamic behaviour of e pump engine v be investigated. The starting will be simulated on a PC and compared with measurement. |
| | Experiment 3: Michelson interferometer and fiber optic: fundamental optical phenonema will be understood and applications wi 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 am Arbeitsplatz. 2. Auf Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1974 Birkle, M.: Meßtechnik für den Immissionsschutz, Messen der gas- und partikelförmigen Luftverunreinigungen. R. Oldenbu Verlag, München-Wien, 1979 Luftbericht 83/84, Freie und Hansestadt Hamburg, Behörde für Bezirksangelegenheiten, Naturschutz und Umweltgestaltur Gebrauchs- und Bedienungsanweisungen VDI-Handbuch Reinhaltung der Luft, Band 5: VDI-Richtlinien 2450 Bl.1, 2451 Bl.4, 2453 Bl.5, 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 Verlag, Heidelberg, 1984 Dakin, J., Cushaw, B.: Optical Fibre Sensors: Principles and Components. Artech House Boston, 1988 Culshaw, B., Dakin, J.: Optical Fibre Sensors: Systems and Application. Artech House Boston, 1989 Versuch 4: Leonhard: Einführung in die Regelungstechnik. Vieweg Verlag, Braunschweig-Wiesbaden Jan Lunze: Systemtheoretische Grundlagen, Analyse und Entwurf einschleifiger Regelungen |

| Course L1116: Measurement | Technology for Mechanical Engineering | | | | |
|---------------------------|---|--|--|--|--|
| Тур | Lecture | | | | |
| Hrs/wk | 2 | | | | |
| СР | 3 | | | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | | | |
| | Prof. Thorsten Kern, Dennis Kähler | | | | |
| Language | | | | | |
| Cycle | | | | | |
| Content | 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 | | | | |
| | 2.6 Data Transmission | | | | |
| | 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 | | | | |
| Literature | Lerch, R.: "Elektrische Messtechnik; Analoge, digitale und computergestützte Verfahren", Springer, 2006, ISBN: 978-3-540-34055- 3. | | | | |
| | Profos, P. Pfeifer, T.: "Handbuch der industriellen Messtechnik", Oldenbourg, 2002, ISBN: 978-3486217940. | | | | |

| Course L1118: Measurement | ourse L1118: Measurement Technology for Mechanical Engineering | | |
|---------------------------|--|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| CP | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Thorsten Kern | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | |
|------------------------------------|--|---|-------------------------|-----------------|
| Title | | Тур | Hrs/wk | СР |
| Introduction to Biochemistry and M | olecular Biology (L0386) | Lecture | 2 | 3 |
| Module Responsible | Prof. Hans-Jürgen Kreienkamp | | | |
| Admission Requirements | None | | | |
| Recommended Previous | None | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students | have reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students can | | | |
| | describe basic biomolecules; | | | |
| | explain how genetic information | is coded in the DNA; | | |
| | explain the connection between | DNA and proteins; | | |
| Chille | The students can | | | |
| SKIIIS | The students can | | | |
| | recognize the importance of mo | lecular parameters for the course of a disease; | | |
| | describe selected molecular-dia | gnostic procedures; | | |
| | explain the relevance of these p | rocedures for some diseases | | |
| Personal Competence | | | | |
| | The students can participate in discuss | sions in research and medicine on a technical leve | el. | |
| | | | | |
| Autonomy | The students can develop understandi | ng of topics from the course, using technical liter | ature, by themselves. | |
| Workload in Hours | Independent Study Time 62, Study Tim | ne in Lecture 28 | | |
| Credit points | 3 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 60 minutes | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German | program, 7 semester): Specialisation Biomedical | Engineering: Compulso | ry |
| Following Curricula | General Engineering Science (Germa | an program, 7 semester): Specialisation Mech | hanical Engineering, Fo | ocus Biomechani |
| | Compulsory | | | |
| | Data Science: Specialisation Medicine: | Compulsory | | |
| | Electrical Engineering: Specialisation M | ledical Technology: Elective Compulsory | | |
| | Engineering Science: Specialisation Bio | omedical Engineering: Compulsory | | |
| | General Engineering Science (English p | program, 7 semester): Specialisation Biomedical B | Engineering: Compulsor | У |
| | General Engineering Science (Englis | h program, 7 semester): Specialisation Mech | nanical Engineering, Fo | ocus Biomechani |
| | Compulsory | | | |
| | Mechanical Engineering: Specialisation | Biomechanics: Compulsory | | |
| | Biomedical Engineering: Specialisation | Management and Business Administration: Elect | ive Compulsory | |
| | Biomedical Engineering: Specialisation | Artificial Organs and Regenerative Medicine: Ele | ctive Compulsory | |
| | Biomedical Engineering: Specialisation | Medical Technology and Control Theory: Elective | e Compulsory | |
| | Biomedical Engineering: Specialisation | Implants and Endoprostheses: Elective Compulse | ory | |
| | Technomathematics: Specialisation III. | Engineering Science: Elective Compulsory | | |

| Course L0386: Introduction t | o 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 | |
| Literature | Müller-Esterl, Biochemie, Spektrum Verlag, 2010; 2. Auflage |
| | Löffler, Basiswissen Biochemie, 7. Auflage, Springer, 2008 |

| Courses | | | | |
|------------------------------------|--|---|--------------------------|------------------|
| Title | | Тур | Hrs/wk | СР |
| Implants and Fracture Healing (L03 | 76) | Lecture | 2 | 3 |
| Module Responsible | Prof. Michael Morlock | | | |
| Admission Requirements | None | | | |
| Recommended Previous | It is recommended to participate in "Introc | luction into Anatomie" before attending "Imp | lants and Fracture Heali | ing". |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students ha | ve reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students can describe the different wa | ays how bones heal, and the requirements fo | r their existence. | |
| | The students can name different treatmen | ts for the spine and hollow bones under give | n fracture morphologies | i. |
| Skills | The students can determine the forces act | ing within the human body under quasi-stati | c situations under speci | fic assumptions. |
| | | 5 | | , |
| Personal Competence | | | | |
| Social Competence | The students can, in groups, solve basic n | umerical modeling tasks for the calculation o | f internal forces. | |
| Autonomy | The students can, in groups, solve basic n | umerical modeling tasks for the calculation o | f internal forces. | |
| Workload in Hours | Independent Study Time 62, Study Time in | Lecture 28 | | |
| Credit points | 3 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German | program, 7 semester): Specialisation Mec | hanical Engineering, F | ocus Biomechani |
| Following Curricula | Compulsory | | | |
| | General Engineering Science (German pro | gram, 7 semester): Specialisation Biomedica | I Engineering: Compulso | ory |
| | Engineering Science: Specialisation Biome | dical Engineering: Compulsory | | |
| | | ram, 7 semester): Specialisation Biomedical | | - |
| | General Engineering Science (English p | program, 7 semester): Specialisation Mec | hanical Engineering, F | ocus Biomechani |
| | Compulsory | | | |
| | Mechanical Engineering: Specialisation Bio | omechanics: Compulsory | | |
| | | plants and Endoprostheses: Elective Compuls | - | |
| | Biomedical Engineering: Specialisation Art | ificial Organs and Regenerative Medicine: Ele | ective Compulsory | |
| | Biomedical Engineering: Specialisation Ma | nagement and Business Administration: Elec | tive Compulsory | |
| | Biomodical Engineering , Engineering | dical Technology and Control Theory: Electiv | e Compulsory | |
| | biomedical Engineering. Specialisation Me | alcal rectificity and control meory. Electiv | compaisory | |
| | Orientation Studies: Core Qualification: Ele | | compaisory | |

| ourse L0376: Implants and | Fracture Healing |
|---------------------------|--|
| Тур | Lecture |
| | 2 |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Michael Morlock |
| Language | DE |
| Cycle | WiSe |
| Content | Topics to be covered include: |
| | 1. 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) |
| | 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 |
| Literature | 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 |
| | Nigg, B.: Biomechanics of the musculo-skeletal system |
| | Schiebler T.H., Schmidt W.: Anatomie |
| | Platzer: dtv-Atlas der Anatomie, Band 1 Bewegungsapparat |
| | |
| | |
| | |

| Courses | | | | | | |
|-------------------------------------|---|------------------------------|-------------------------------|-------------------------|---------------|------------------|
| Title | | | Тур | | Hrs/wk | СР |
| Embodiment Design and 3D-CAD (L | 0268) | | Lecture | | 2 | 1 |
| Mechanical Design Project I (L0695 | | | | oblem-based Learning | 3 | 2 |
| Mechanical Design Project II (L0592 | | | | oblem-based Learning | 3 | 2 |
| Team Project Design Methodology | | | | oblem-based Learning | 2 | 1 |
| Module Responsible | Prof. Dieter Krause | | | | | |
| Admission Requirements | | | | | | |
| Recommended Previous | None | | | | | |
| | Fundamentals | s of Mechanical Engineering |) Design | | | |
| Knowledge | Mechanics | | | | | |
| | Fundamentals | s of Materials Science | | | | |
| | Production En | igineering | | | | |
| | A.C | | | | | |
| Educational Objectives | After taking part suc | cessfully, students have re | ached the following learning | , results | | |
| Professional Competence | A fter an end of the second | | | | | |
| Knowledge | After passing the mo | odule, students are able to: | | | | |
| | explain design | n guidelines for machinery | parts e.g. considering load s | ituation, materials an | d manufactur | ing requirements |
| | describe basic | cs of 3D CAD, | | | | |
| | explain basics | s methods of engineering d | esigning. | | | |
| | | | | | | |
| Skills | After passing the mo | odule, students are able to: | | | | |
| | independently | v create sketches. technica | I drawings and documentation | ons e.a. usina 3D CAD |). | |
| | | onents based on design gui | - | | , | |
| | | alculate) used components, | ,,, | | | |
| | | | ering design tasks systamtic | ally and solution-orie | nted. | |
| | use methods to design and solve engineering design tasks systamtically and solution-oriented, apply creativity techniques in teams. | | | | | |
| | | -, | | | | |
| Personal Competence | | | | | | |
| 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 | | | | | |
| | | | | | | |
| | | | | | | |
| | present and discuss solutions and technical drawings within groups, reflect the own results in the work groups of the course. | | | | | |
| | · Teneet the ow | in the work group | s of the course. | | | |
| Autonomy | Students are able | | | | | |
| | to optimate t | hair laval of knowladga usi | a activating mothods withi | n the lectures (e.g. wi | ith clickors) | |
| | to estimate their level of knowledge using activating methods within the lectures (e.g. with clickers), To solve engineering design tasks systematically. | | | | | |
| | To solve eligit | neering design tasks system | natically. | | | |
| Workload in Hours | Independent Study | Time 40, Study Time in Lec | ture 140 | | | |
| Credit points | 6 | | | | | |
| Course achievement | | Form | Description | | | |
| | Yes None | Written elaboration | 3D-CAD-Praktikum | | | |
| | Yes None | Written elaboration | Teamprojekt Konstruktio | onsmethodik | | |
| | Yes None | Written elaboration | Konstruktionsprojekt 1 | | | |
| | Yes None | Written elaboration | Konstruktionsprojekt 2 | | | |
| Examination | Written exam | | | | | |
| Examination duration and | 180 | | | | | |
| scale | | | | | | |
| Assignment for the | General Engineering | Science (German program | , 7 semester): Specialisatior | 1 Mechanical Engineer | ring: Compuls | ory |
| Following Curricula | | | , 7 semester): Specialisation | - | | - |
| | General Engineering | Science (German program | , 7 semester): Specialisatior | 1 Biomedical Engineer | ing: Compuls | ory |
| | Digital Mechanical E | ngineering: Core Qualificat | on: Compulsory | | | |
| | Energy and Environr | mental Engineering: Core Q | ualification: Compulsory | | | |
| | Engineering Science | : Core Qualification: Comp | Ilsory | | | |
| | General Engineering | Science (English program, | 7 semester): Specialisation | Biomedical Engineeri | ng: Compulso | ry |
| | Green Technologies | Energy, Water, Climate: S | pecialisation Energy Technol | logy: Elective Compul | sory | |
| | Mechanical Engineer | ring: Core Qualification: Co | mpulsory | | | |
| | Mechatronics: Core | Qualification: Compulsory | | | | |
| | | | | | | |

| Course L0268: Embodiment I | Design and 3D-CAD |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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. Maschinenelemente, Band I-III; Niemann, G., 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 De | esign Project I |
|-----------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 3 |
| CP | 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 D | esign Project II |
|----------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 3 |
| CP | 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. |

| ourse L0267: Team Project | |
|---------------------------|---|
| ,, | Project-/problem-based Learning |
| Hrs/wk | 2 |
| CP | 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 | | | | | |
|------------------------------------|----------------------|--------------------------------------|---|---------------------|---------------------|
| Title | | | Тур | Hrs/wk | СР |
| ntroduction into Medical Technolog | gy and Systems (L034 | 2) | Lecture | 2 | 3 |
| ntroduction into Medical Technolog | gy and Systems (L034 | 3) | Project Seminar | 2 | 2 |
| ntroduction into Medical Technolog | gy and Systems (L187 | 6) | Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof. Alexander Sch | hlaefer | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | principles of math (| (algebra, analysis/calculus) | | | |
| Knowledge | principles of stocha | astics | | | |
| | principles of progra | mming, R/Matlab | | | |
| Educational Objectives | After taking part si | ccessfully, students have reache | ed the following learning results | | |
| Professional Competence | | | | | |
| - | The students can | explain principles of medical to | echnology, including imaging systems, c | omputer aided s | urgery and medi |
| Knowledge | | | view of regulatory affairs and standards in | | |
| | internation system | | | | -97 |
| Skills | The students are al | ble to evaluate systems and med | dical devices in the context of clinical appl | ications. | |
| Personal Competence | | | | | |
| - | The students descr | ibe a problem in medical techno | logy as a project, and define tasks that an | e solved in a joint | effort. |
| | | | | , | |
| Autonomy | The students can r | eflect their knowledge and docu | ment the results of their work. They can | present the resu | Its in an appropria |
| | manner. | | | | |
| Workload in Hours | Independent Study | Time 110, Study Time in Lectur | e 70 | | |
| Credit points | 6 | | | | |
| Course achievement | Compulsory Bonus | Form | Description | | |
| | Yes 10 % | Presentation | | | |
| | Yes 10 % | Written elaboration | | | |
| Examination | Written exam | | | | |
| Examination duration and | 90 minutes | | | | |
| scale | | | | | |
| Assignment for the | General Engineerin | g Science (German program, 7 s | emester): Specialisation Biomedical Engir | eering: Compulso | ory |
| Following Curricula | Computer Science: | Specialisation Computer and So | ftware Engineering: Elective Compulsory | | |
| | | | nd Engineering Science: Elective Compuls | ory | |
| | | Qualification: Elective Compulse | • | | |
| | Electrical Engineeri | ng: Core Qualification: Elective (| Compulsory | | |
| | Engineering Science | e: Specialisation Biomedical Eng | ineering: Compulsory | | |
| | General Engineerin | g Science (English program, 7 se | emester): Specialisation Biomedical Engine | eering: Compulso | ry |
| | Computational Scie | ence and Engineering: Specialisa | tion II. Mathematics & Engineering Science | e: Elective Compu | ilsory |
| | Biomedical Enginee | ering: Specialisation Artificial Org | ans and Regenerative Medicine: Elective | Compulsory | |
| | Biomedical Enginee | ering: Specialisation Implants and | d Endoprostheses: Elective Compulsory | | |
| | Biomedical Enginee | ering: Specialisation Medical Tec | hnology and Control Theory: Elective Com | pulsory | |
| | Biomedical Enginee | ering: Specialisation Managemen | t and Business Administration: Elective Co | ompulsory | |
| | | | | | |

| Course L0342: Introduction in | Course L0342: Introduction 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: Introduction i | Course L0343: Introduction into Medical Technology and Systems | |
|------------------------------|--|--|
| Тур | Project Seminar | |
| Hrs/wk | 2 | |
| CP | 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: Introduction i | nto Medical Technology and Systems |
|------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| CP | 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. |

| Courses | | | | |
|-----------------------------------|---|---|----------------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| ntroduction to Physiology (L0385) | | Lecture | 2 | 3 |
| Module Responsible | Dr. Roger Zimmermann | | | |
| Admission Requirements | None | | | |
| Recommended Previous | None | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students | have reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students can | | | |
| | describe the basics of the energy | v metabolism: | | |
| | | in selected fields of muscle, heart/circulation, r | neuro- and sensory physic | ology. |
| | | | icare and sensory physic | 0.0991 |
| Skills | | of basic bodily functions (sensory, transmission | n and processing of infor | mation, developm |
| | of forces and vital functions) and relate | them to similar technical systems. | | |
| Personal Competence | | | | |
| Social Competence | | n research and medicine on a technical level. | | |
| | The students can find solutions to prob | lems in the field of physiology, both analytical | and metrological. | |
| Autonomv | The students can derive answers to g | uestions arising in the course and other phys | siological areas, using te | chnical literature |
| | themselves. | | | |
| | | | | |
| | Independent Study Time 62, Study Tim | e in Lecture 28 | | |
| Credit points | 3 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 60 minutes | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German | program, 7 semester): Specialisation Biomedic | al Engineering: Compulse | ory |
| Following Curricula | General Engineering Science (Germa | n program, 7 semester): Specialisation Me | echanical Engineering, F | Focus Biomechan |
| | Compulsory | | | |
| | Data Science: Specialisation Medicine: | | | |
| | | edical Technology: Elective Compulsory | | |
| | | medical Engineering: Elective Compulsory | | |
| | | h program, 7 semester): Specialisation Me | echanical Engineering, F | Focus Biomechan |
| | Compulsory | warmen Zaamaatan) Caasialiaatian Diawaadia | | |
| | | rogram, 7 semester): Specialisation Biomedica | | - |
| | | rogram, 7 semester): Specialisation Biomedica | al Engineering: Elective C | ompulsory |
| | Mechanical Engineering: Specialisation | | ivo Compulsony | |
| | | Medical Technology and Control Theory: Elect Management and Business Administration: Elect | | |
| | | Artificial Organs and Regenerative Medicine: E | | |
| | | Implants and Endoprostheses: Elective Compu | | |
| | | Engineering Science: Elective Compulsory | | |

| Course L0385: Introduction to Physiology | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| CP | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Dr. Gerhard Engler | |
| Language | DE | |
| Cycle | SoSe | |
| Content | | |
| Literature | Taschenatlas der Physiologie, Silbernagl Despopoulos, ISBN 978-3-135-67707-1, Thieme | |
| | Repetitorium Physiologie, Speckmann, ISBN 978-3-437-42321-5, Elsevier | |

| ourses | | | | |
|---------------------------------|--|---|--------------------------|------------------------------------|
| tle | | Тур | Hrs/wk | СР |
| perimental Methods in Biomechar | nics (L0377) | Lecture | 2 | 3 |
| Module Responsible | Prof. Michael Morlock | | | |
| Admission Requirements | None | | | |
| Recommended Previous | It is recommended to participate in "Imp | lantate und Frakturheilung" before attending ' | 'Experimentelle Methode | en". |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students h | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students can describe the different v | vays how bones heal, and the requirements fo | or their existence. | |
| | The students can name different treatme | ents for the spine and hollow bones under give | en fracture morphologies | 5. |
| | The students can describe different mea | surement techniques for forces and movemer | its, and choose the adec | uate technique fo |
| | given task. | · | | |
| <i>ci "</i> | | | | |
| SKIIIS | The students can describe the basic hand | dling of several experimental techniques used | in biomechanics. | |
| Personal Competence | | | | |
| Social Competence | The students can, in groups, solve basic | experimental tasks. | | |
| Autonomic | The students can, in groups, solve basic | | | |
| Autonomy | The students can, in groups, solve basic | experimental tasks. | | |
| Workload in Hours | Independent Study Time 62, Study Time | in Lecture 28 | | |
| Credit points | 3 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| - | | program, 7 semester): Specialisation Med | chanical Engineering, F | ocus Biomechani |
| Following Curricula | | | | |
| | | ogram, 7 semester): Specialisation Biomedica | I Engineering: Compulso | bry |
| | Engineering Science: Specialisation Biom | edical Engineering: Elective Compulsory | | |
| | | program, 7 semester): Specialisation Mec | hanical Engineering, F | ocus Biomechani |
| | Compulsory | | | |
| | | ogram, 7 semester): Specialisation Biomedical | | - |
| | General Engineering Science (English pro | ogram, 7 semester): Specialisation Biomedical | Engineering: Elective C | ompulsory |
| | Mechanical Engineering: Specialisation B | iomechanics: Compulsory | | |
| | General Engineering Science (English pro General Engineering Science (English pro | ogram, 7 semester): Specialisation iomechanics: Compulsory | Biomedical | Biomedical Engineering: Elective C |

| 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.

| Module M0730: Comp | outer Engineering | | | |
|------------------------------|--|-------------------------------------|-------------------|-----------------------|
| Courses | | | | |
| Title | | Tun | Hrs/wk | СР |
| Computer Engineering (L0321) | | Typ Lecture | 3 | 4 |
| Computer Engineering (L0324) | | Recitation Section (small) | 1 | 2 |
| Module Responsible | Drof Hoiko Falk | | | |
| | | | | |
| Admission Requirements | None | | | |
| | Basic knowledge in electrical engineering | | | |
| Knowledge | | | | |
| - | After taking part successfully, students have reached the follo | owing 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 followi | ng topics: | | |
| | Introduction | | | |
| | Combinational logic: Gates, Boolean algebra, Boolean 1 | functions bardware synthesis cor | mbinational netw | vorks |
| | Sequential logic: Flip-flops, automata, systematic hards | | | Vorits |
| | Technological foundations | ware design | | |
| | - | Itiplication and division | | |
| | Computer arithmetic: Integer addition, subtraction, mu Basics of computer architecture: Programming models, | | ipolining | |
| | | , Mirs single-cycle architecture, p | ipenning | |
| | Memories: Memory hierarchies, SRAM, DRAM, caches Input/outputs I/O from the perception of the CRU, price | ciplos of passing data point to pa | int connections | huccoc |
| | Input/output: I/O from the perspective of the CPU, print | cipies of passing data, point-to-po | int connections, | busses |
| Skills | The students perceive computer systems from the architect's | perspective, i.e., they identify th | e internal struct | ure and the physical |
| | composition of computer systems. The students can analyze, | how highly specific and individua | al computers car | be built based on a |
| | collection of few and simple components. They are able to c | | | |
| | today's computing systems - from gates and circuits up to co | mplete processors. | | |
| | | | | |
| | After successful completion of the module, the students are | e able to judge the interdepende | ncies between a | a physical computer |
| | system and the software executed on it. In particular, they s | hall understand the consequence | s that the execu | ition of software has |
| | on the hardware-centric abstraction layers from the assembly | y language down to gates. This w | ay, they will be | enabled to evaluate |
| | the impact that these low abstraction levels have on an entire | e system's performance and to pro | opose feasible o | ptions. |
| Personal Competence | | | | |
| | Chudonka are able to achue similar problems alone ar in a grou | and to present the results acces | und in out of | |
| Social Competence | Students are able to solve similar problems alone or in a grou | ip and to present the results accol | aingly. | |
| Autonomy | Students are able to acquire new knowledge from specific lite | erature and to associate this know | ledge with other | r classes. |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | | | | |
| Course achievement | | | | |
| course achievement | Yes 10 % Excercises | | | |
| Examination | Written exam | | | |
| | 90 minutes, contents of course and labs | | | |
| scale | | | | |
| | General Engineering Science (German program, 7 semester): | Specialisation Computer Science | Compulsory | |
| - | General Engineering Science (German program, 7 semester): | | | rv. |
| r onowing curricula | General Engineering Science (German program, 7 semester): | | | y |
| | General Engineering Science (German program, 7 semester): | • | | , |
| | General Engineering Science (German program, 7 semester): | 1 5 | 5 1 5 | |
| | General Engineering Science (German program, 7 semester): | | | - |
| | General Engineering Science (German program, 7 semester): General Engineering Science (German program, 7 semester): | | - | ing. compulsory |
| | General Engineering Science (German program, 7 semester). | | | ocus Mochatronics: |
| | | ster). Specialisation Mechanical | Lingineering, i | ocus mechacionics. |
| | Compulsory | stor). Creatilization Machanical | | acus Diamashanisa |
| | General Engineering Science (German program, 7 semes | ster). Specialisation Mechanical | Engineering, F | beus biomechanics. |
| | Compulsory | | | Alizza fit. Constants |
| | General Engineering Science (German program, 7 semest | er, specialisation Mechanical E | igineering, roo | us Anciait Systems |
| | Engineering: Compulsory | sctor). Specialization Machaning | Engineering | Focus Matoriala |
| | General Engineering Science (German program, 7 seme | ssien, specialisation Mechanica | i Engineering, | i ocus materiais IN |
| | Engineering Sciences: Compulsory | Charing Machanism Tra | oring Factor | oprotical Mash-site |
| | General Engineering Science (German program, 7 semester): | specialisation Mechanical Engine | ering, Focus Th | euretical Mechanical |
| | Engineering: Compulsory | | | |
| | General Engineering Science (German program, 7 semester) | : Specialisation Mechanical Engin | eering, Focus Pi | roauct Development |
| | and Production: Compulsory | | – | |
| | General Engineering Science (German program, 7 semester | er): Specialisation Mechanical Er | igineering, Focu | is Energy Systems: |
| | Compulsory | | | _ |
| | General Engineering Science (German program, 7 semeste | er): Specialisation Mechanical Er | ngineering, Focu | us Energy Systems: |
| l | Compulsory | | | I |

| General Engineering Science (German program, 7 semester): Specialisation Civil Engineering: Compulsory |
|--|
| Computer Science: Core Qualification: Compulsory |
| Data Science: Core Qualification: Elective Compulsory |
| Electrical Engineering: Core Qualification: Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Electrical Engineering: Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Civil 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 Computer Science: 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 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 Naval Architecture: Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory |
| General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory |
| Computational Science and Engineering: Core Qualification: Compulsory |
| Mechatronics: Core Qualification: Compulsory |
| Technomathematics: Specialisation II. Informatics: Elective Compulsory |

| Course L0321: Computer Eng | jineering | |
|----------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| CP | 4 | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE/EN | |
| 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. | |

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

| Hydro | ostatics and Body Plan | | | |
|---|--|---|---------------------|----------------------|
| Courses | | | | |
| itle | | Тур | Hrs/wk | СР |
| lydrostatics (L1260) | | Lecture | 2 2 | 3 1 |
| lydrostatics (L1261) ody Plan (L1452) | | Recitation Section (large) Project Seminar | 2 | 2 |
| Module Responsible | Prof. Stefan Krüger | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Good knowledge in Mathemathics I-III and Mechanics I-III. | | | |
| Knowledge | It is recommended that the students are familiar with typi | cal design relevant drawings e.g. B | ody Plan GA- Pla | an Tank Plan etc |
| | | car acolgi i relevane aratimigo, elgi o | | |
| | After taking part successfully, students have reached the | following learning results | | |
| Professional Competence | The lastice enclose the student to some suit all persons | , the excitical calculations for ship de | ainn an a caiont | if a lovel The lest |
| Knowledge | The lecture enables the student to carry out all necessar is basic requirement for all following lectures in the subject | | esign on a scient | inc level. The lectu |
| | is busic requirement for an following rectares in the subject | to shipe design and safety of ships. | | |
| Skills | The student is able to carry out hydrostatic calculations | to ensure that the ship has sufficie | ent stability. He i | s able to design hu |
| | forms that are safe against capsizing or sinking. | | | |
| Personal Competence | | | | |
| Social Competence | The student gets access to hydrostatical problems. | | | |
| Autonomy | | | | |
| | Independent Study Time 96, Study Time in Lecture 84 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 180 min | | | |
| scale | | | | |
| | General Engineering Science (German program, 7 semest | | | |
| Following Curricula | General Engineering Science (German program, 7 semest General Engineering Science (English program, 7 semeste | | | |
| | General Engineering Science (English program, 7 semeste | | | |
| | Naval Architecture: Core Qualification: Compulsory | | | |
| | | | | |
| | | | | |
| Course L1260: Hydrostatics | | | | |
| Тур | Lecture | | | |
| Typ Hrs/wk | 2 | | | |
| Typ Hrs/wk CP | 2 3 | | | |
| Typ Hrs/wk CP Workload in Hours | 2 3 Independent Study Time 62, Study Time in Lecture 28 | | | |
| Typ Hrs/wk CP Workload in Hours | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger | | | |
| Typ Hrs/wk CP Workload in Hours Lecturer | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE | | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE | | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation | tegration Methods | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In | tegration Methods | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation | tegration Methods | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In | tegration Methods | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In - Determination of Areas, 1st and 2nd order Moments | tegration Methods | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy | tegration Methods | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation | tegration Methods | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy | tegration Methods | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equlibrium Floating Condition | tegration Methods | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equlibrium Floating Condition - Equlibrium Computations | tegration Methods | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equlibrium Floating Condition | tegration Methods | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equlibrium Floating Condition - Equlibrium Computations | tegration Methods | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equlibrium Floating Condition - Equlibrium Computations - Hydrostatic Tables and Sounding Tables - Trim Tables | tegration Methods | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium Computations - Hydrostatic Tables and Sounding Tables - Trim Tables 3. Stability at large heeling angles | tegration Methods | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equlibrium Floating Condition - Equlibrium Computations - Hydrostatic Tables and Sounding Tables - Trim Tables | tegration Methods | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium Computations - Hydrostatic Tables and Sounding Tables - Trim Tables 3. Stability at large heeling angles | tegration Methods | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium Computations - Hydrostatic Tables and Sounding Tables - Trim Tables 3. Stability at large heeling angles - Stability Equation - Cross Curves of Stability and Righting Levers | | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium 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 Curve | - | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium Computations - Hydrostatic Tables and Sounding Tables - Trim Tables 3. Stability at large heeling angles - Stability Equation - Cross Curves of Stability and Righting Levers | - | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium 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 Curve | - | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium 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 Curve - Heeling Moments of Different Type | es ter Ingress | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium 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 Curve - Heeling Moments of Free Surfaces, Water on Deck, Wa - Heeling Moments of Different Type - Balance of Heeling and Righting Moments acc. to BV 1 | es ter Ingress | | |
| Typ Hrs/wk CP Workload in Hours Lecturer Language Cycle | 2 3 Independent Study Time 62, Study Time in Lecture 28 Prof. Stefan Krüger DE SoSe 1. Numerical Integration, Diffrentation, Interpolation - Trapezoidal Rule, Simpson, Tschebyscheff, graphical In - Determination of Areas, 1st and 2nd order Moments - Numerical Diffrentation, Spline Interpolation 2. Buyoancy - Principle of Archimedes - Equilibrium Floating Condition - Equilibrium 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 Curve - Heeling Moments of Free Surfaces, Water on Deck, Wa - Heeling Moments of Different Type | es ter Ingress | | |

| - Linearization of Restoring Fo | rces and Moments |
|----------------------------------|---|
| - Correlation between Metacer | ntric Height and Righting Lever at small heeling angles |
| - Computation of Path of Meta | centric Height for Modern Hull Forms |
| - Correlation between Righting | JLever and Path of Metacentric Height |
| - Hydrostatic Stiffness Matrix | |
| - Definition of MCT | |
| - Computation of Equilibrum F | loating Conditions from Hydrostatic Tables |
| - Effect of Free Surfaces on Ini | tial GM |
| - Roll Motions at Small Roll An | gles |
| 6. Stability in Waves | |
| - Roll Motions at Large Amplitu | ıdes |
| - Pure Loss of Stability on the | Wave Crest |
| - Principle of Parametric Excita | ation |
| - Principle of Direct Wave Mon | nents |
| - Grim´s Equivalent Wave Con | cept |
| 6 Longitudinal Strength | |
| - Longitudinal Mass Distributio | n, Shear Forces, Bending Moments |
| - Longitudinal Strength in Stat | ility Booklet |
| 7. Deadweight Survey and Inclir | ing Experiment |
| - Deplacement Computations | from Draft mark Readings |
| - Weights to go on /come from | board |
| - Inclining Experiment with He | eling Moments from Weights and Heeling Tanks |
| - Residual Sounding Volumes | |
| - Determination of COG from N | Aetacentric height and from Cross Curves |
| - Roll Decay Test | |
| 8. Launching and Docking | |
| - Launching Plan, Arrangemer | nt of Launching Blocks |
| - Rigid Body Launching: Tiltin | g, Dumping, Equation of Techel |
| - Computation of Launching E | vent |
| - Bottom Pressure and Longit | udinal Strength |
| - Linear- Elastic Effects | |
| - Transversal Stability on Slip | way and in Dock |
| 9. Grounding | |
| - Loss of Buoynacy when Grou | nded |
| - Pointwise Grounding | |
| - Ship Grounds on Keel | |
| 10. Introduction into Damage St | ability Problems |
| - Added Mass Method | |
| - Loss of Buoyant Volume Me | hod |
| - Simple Equilibrium Compute | tions |
| - Intermediate Stages of Floor | ding (Addes Mass Method), Cross- and Downflooding |
| - Water Ingress Through Oper | nings |
| 11. Special Problems (optional a | nd agreed upon) |
| - e.g. Heavy Lift Operations | |
| - e.g. Jacking of Jackup Vesse | s |
| - e.g. Sinking After Water Ing | ress |

| 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. |

| 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 Plan | |
|-------------------------|--|
| 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 | Herner/Rusch: Die Theorie des Schiffes Fachbuchverlag Leipzig Henschke Schiffstechnisches Handbuch, Band 1 VEB Technik Verlag Berlin Das Skript zur Vorlesung, Anwendungsbeispiele und Klausuren sind auf unserer Homepage abrufbar. |

| Courses | | | | |
|---|---|---|--|-----------------|
| | | _ | | |
| Title Fundamentals of Materials Science | 1 (11095) | Typ Lecture | Hrs/wk 2 | CP 2 |
| Fundamentals of Materials Science I (L1085) Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) (L0506) | | Lecture | 2 | 2 |
| Physical and Chemical Basics of Materials Science (L1095) | | Lecture | 2 | 2 |
| Module Responsible | | | | |
| Admission Requirements | None | | | |
| | Highschool-level physics, chemistry und mathematics | | | |
| Knowledge | righschool-ever physics, chemistry and mathematics | | | |
| Educational Objectives | After taking part successfully, students have reached the follow | ving learning results | | |
| Professional Competence | | | | |
| Knowledge | The students have acquired a fundamental knowledge on metals, ceramics and polymers and can describe this knowled comprehensively. Fundamental knowledge here means specifically the issues of atomic structure, microstructure, phase diagra phase transformations, corrosion and mechanical properties. The students know about the key aspects of characterization meti for materials and can identify relevant approaches for characterizing specific properties. They are able to trace mater phenomena back to the underlying physical and chemical laws of nature. | | | |
| Skills | | | | |
| Personal Competence | | | | |
| Social Competence | _ | | | |
| Autonomy | - | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 | | | |
| | | | | |
| Credit points | | | | |
| Course achievement | | | | |
| | Written exam | | | |
| Examination duration and | 180 min | | | |
| scale | | | | |
| - | General Engineering Science (German program, 7 semester): S | | | - |
| Following Curricula | General Engineering Science (German program, 7 semester): Sp | | | |
| | General Engineering Science (German program, 7 semester): Sp | | | ing: Compulsory |
| | General Engineering Science (German program, 7 semester): Sp | | | |
| | General Engineering Science (German program, 7 semester): Sp | pecialisation Naval Arcr | nitecture: Compulsory | |
| | Data Science: Specialisation Materials Science: Compulsory Digital Mechanical Engineering: Core Qualification: Compulsory | | | |
| | Energy and Environmental Engineering: Core Qualification: Computering | | | |
| | | | Enviromental Engineeri | |
| | | | i Enviromentai Engineen | |
| | General Engineering Science (English program, 7 semester): Sp | | Engineering: Computer | |
| | General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp | ecialisation Mechanical | | |
| | General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp | ecialisation Mechanical ecialisation Naval Archi | itecture: Compulsory | ry |
| | General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp | ecialisation Mechanical ecialisation Naval Archi ecialisation Biomedical | itecture: Compulsory Engineering: Compulsor | ry |
| | General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp | ecialisation Mechanical becialisation Naval Archi becialisation Biomedical becialisation Naval Archi | itecture: Compulsory Engineering: Compulsor | ŷ |
| | General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp Logistics and Mobility: Specialisation Engineering Science: Elect | ecialisation Mechanical becialisation Naval Archi becialisation Biomedical becialisation Naval Archi | itecture: Compulsory Engineering: Compulsor | ry |
| | General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp Logistics and Mobility: Specialisation Engineering Science: Elect Mechanical Engineering: Core Qualification: Compulsory | ecialisation Mechanical becialisation Naval Archi becialisation Biomedical becialisation Naval Archi | itecture: Compulsory Engineering: Compulsor | ry |
| | General Engineering Science (English program, 7 semester): Sp General Engineering Science (English program, 7 semester): Sp Logistics and Mobility: Specialisation Engineering Science: Elect | ecialisation Mechanical becialisation Naval Archi becialisation Biomedical becialisation Naval Archi | itecture: Compulsory Engineering: Compulsor | ŷ |

| Course L1085: Fundamentals | s of Materials Science I | |
|----------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| CP | 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 P. Haasen: Physikalische Metallkunde. Springer 1994 | |

| Course L0506: Fundamentals of Materials Science II (Advanced Ceramic Materials, Polymers and Composites) | | |
|--|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| CP | 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 O | 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 Fritz 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 M0854: Math | ematics IV | | | |
|--|---|--|-------------------|---------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Differential Equations 2 (Partial Dif | ferential Equations) (L1043) | Lecture | 2 | 1 |
| Differential Equations 2 (Partial Dif | ferential Equations) (L1044) | Recitation Section (small) | 1 | 1 |
| Differential Equations 2 (Partial Dif | ferential 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 None | | | |
| Admission Requirements Recommended Previous | | | | |
| Knowledge | | | | |
| | After taking part successfully, students have reached | the following learning results | | |
| Professional Competence | | | | |
| Knowledge | | | | |
| | Students can name the basic concepts in Math Students can discuss logical connections betw the help of examples. They know proof strategies and can reproduce | ween these concepts. They are capable | | |
| Skills | Students can model problems in Mathematics IV with the help of the concepts studied in this course. Moreover, they a 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 th results. | | | |
| Personal Competence Social Competence | | | | |
| Autonomy | Students are capable of checking their understanding of complex concepts on their own. They can specify open question precisely and know where to get help in solving them. Students have developed sufficient persistence to be able to work for longer periods in a goal-oriented manner on har problems. | | | |
| Workload in Hours | Independent Study Time 68, Study Time in Lecture 1 | 12 | | |
| Credit points | 6 | | | |
| Course achievement | | | | |
| | | | | |
| Examination | | | | |
| Examination duration and | 60 min (Complex Functions) + 60 min (Differential E | quations 2) | | |
| scale | | | | |
| Assignment for the | 5 5 7 7 5 7 | | | |
| Following Curricula | 5 5 7 7 5 7 | / semester): Specialisation Mechanica | I Engineering, | Focus Mechatronic |
| | Compulsory | | | |
| | General Engineering Science (German program, 7 se | | | |
| | General Engineering Science (German program, 7 se | emester): Specialisation Mechanical Engi | neering, Focus Tl | heoretical Mechanic |
| | Engineering: Elective Compulsory | | | |
| | Computer Science: Specialisation Computational Mat | | | |
| | Computer Science: Specialisation II. Mathematics and | | ory | |
| | Electrical Engineering: Core Qualification: Compulsor | ТУ | | |
| | Engineering Science: Specialisation Electrical Engine | ering: Compulsory | | |
| | General Engineering Science (English program, 7 ser | mester): Specialisation Electrical Enginee | ring: Compulsory | / |
| | General Engineering Science (English program, 7 ser | mester): Specialisation Electrical Enginee | ring: Compulsory | / |
| | General Engineering Science (English program, | 7 semester): Specialisation Mechanica | I Engineering, | Focus Mechatroni |
| | Compulsory | | | |
| | General Engineering Science (English program, 7 se | mester): Specialisation Mechanical Engir | neering, Focus Ti | neoretical Mechani |
| | Engineering: Compulsory General Engineering Science (English program, 7 ser Computational Science and Engineering: Specialisati Mechanical Engineering: Specialisation Mechatronics | on II. Mathematics & Engineering Science | | ulsory |
| | Mechanical Engineering: Specialisation Theoretical M | | ory | |
| | Mechanical Engineering: Specialisation Theoretical M | | | |
| | Mechatronics: Core Qualification: Compulsory | | | |
| | Naval Architecture: Core Qualification: Compulsory | | | |
| | | | | |
| 1 | 1 | | | |

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

| Course L1043: Differential Equations 2 (Partial Differential Equations) | | |
|---|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| CP | 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 | |
| Literature | 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 |
| CP | 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 E | urse L1045: Differential Equations 2 (Partial Differential Equations) | |
|------------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | 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 | |

| ourse L1038: Complex Functions | | |
|--------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| CP | 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 Fund | Course L1041: Complex Functions | |
|----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| CP | 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 Fund | ourse L1042: Complex Functions | |
|----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | 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 | |

| Courses | | | | |
|----------------------------|--|---|--------------------|---------------------|
| Title | | Тур | Hrs/wk | СР |
| - | al Mechanics, Numerical Mechanics) (L1137) | Lecture | 3 | 3 |
| | al Mechanics, Numerical Mechanics) (L1138) | Recitation Section (small) | 2 | 2 |
| | al Mechanics, Numerical Mechanics) (L1139) | Recitation Section (large) | 1 | 1 |
| Module Responsible | | | | |
| Admission Requirements | | | | |
| Recommended Previous | Mathematics I-III and Mechanics I-III | | | |
| Knowledge | | | | |
| | After taking part successfully, students have reached | I the following learning results | | |
| Professional Competence | The shudents con | | | |
| Knowledge | The students can | | | |
| | describe the axiomatic procedure used in mech | hanical contexts; | | |
| | explain important steps in model design; | | | |
| | present technical knowledge. | | | |
| Skills | The students can | | | |
| | | | | |
| | explain the important elements of mathematic | cal / mechanical analysis and model for | mation, and appl | y it to the context |
| | 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. | | | |
| | • estimate the reach and boundaries of the metr | nous and extend them to be applicable t | o wider problem | sets. |
| | | | | |
| Personal Competence | | | | |
| | The students can work in groups and support each of | ther to overcome difficulties | | |
| Social competence | The students can work in groups and support each other to overcome difficulties. | | | |
| Autonomy | Students are capable of determining their own streng | gths and weaknesses and to organize the | eir time and learn | ing based on those |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 | 4 | | |
| Credit points | | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 ser | mester): Specialisation Mechanical Engin | eering: Compuls | ory |
| Following Curricula | General Engineering Science (German program, 7 ser | mester): Specialisation Biomedical Engin | eering: Compulso | ory |
| | General Engineering Science (German program, 7 ser | mester): Specialisation Naval Architectur | e: Compulsory | |
| | Energy Systems: Technical Complementary Course Co | ore Studies: Elective Compulsory | | |
| | General Engineering Science (English program, 7 sem | | | ry |
| | General Engineering Science (English program, 7 sem | | | |
| | General Engineering Science (English program, 7 sem | | eering: Compulso | ry |
| | Mechanical Engineering: Core Qualification: Compulso | ory | | |
| | Mechatronics: Core Qualification: Compulsory | | | |
| | Naval Architecture: Core Qualification: Compulsory Technomathematics: Specialisation III. Engineering So | cience: Elective Compulsory | | |
| | Theoretical Mechanical Engineering: Technical Compl | | Compulsory | |
| | Theoretical Prechanical Engineering. Technical Compl | construction studies. Elective | compaisory | |
| Course L1137: Mechanics IV | (Oscillations, Analytical Mechanics, Numerical M | lechanics) | | |
| Тур | | | | |
| Hrs/wk | | | | |
| 111 3/ WK | | | | |
| CB | 3 | | | |
| CP Workload in Hours | | 2 | | |
| | Independent Study Time 48, Study Time in Lecture 42 | 2 | | |

| Language | DE |
|------------|--|
| Cycle | SoSe |
| Content | |
| | Elements of vibration theory Vibration of Multi-degree of freedom systems Analytical Mechanics 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 | (Oscillations, Analytical Mechanics, Numerical Mechanics) |
|----------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| CP | 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 | (Oscillations, Analytical Mechanics, Numerical Mechanics) |
| 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

Content

SoSe

Literature See interlocking course

See interlocking course

| Module M0680: Fluid | Dynamics | | | |
|-----------------------------|--|----------------------------------|------------------|-----|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Fluid Mechanics (L0454) | | Lecture | 3 | 4 |
| Fluid Mechanics (L0455) | | Recitation Section (large) | 2 | 2 |
| Module Responsible | Prof. Thomas Rung | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Sound knowledge of engineering mathematics, engineering n | nechanics and thermodynamics. | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the follo | owing learning results | | |
| Professional Competence | | | | |
| Knowledge | Students will have the required sound knowledge to expla Students can scientifically outline the rationale of flow physi performance analysis and the prediciton of fluid engineering | cs using mathematical models a | | |
| Skills | Students are able to apply fluid-engineering principles and flow-physics models for the analysis of technical systems. The lectur enables the student to carry out all necessary theoretical calculations for the fluid dynamic design of engineering devices on scientific level. | | | |
| Personal Competence | | | | |
| - | The students are able to discuss problems and jointly develop | o solution strategies. | | |
| Autonomy | The students are able to develop solution strategies for complex problems self-consistent and crtically analyse results. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | | | | |
| Examination duration and | | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 semester): | Specialisation Mechanical Engin | eering: Compulse | ory |
| Following Curricula | | | ÷ . | - |
| | General Engineering Science (German program, 7 semester): | | | 5 |
| | General Engineering Science (English program, 7 semester): | | | ry |
| | General Engineering Science (English program, 7 semester): | | | |
| | General Engineering Science (English program, 7 semester): | Specialisation Biomedical Engine | ering: Compulsor | ТУ |
| | Computational Science and Engineering: Specialisation Engin | eering Sciences: Elective Compu | lsory | |
| | Mechanical Engineering: Core Qualification: Compulsory | | | |
| | Naval Architecture: Core Qualification: Compulsory | | | |
| | Technomathematics: Specialisation III. Engineering Science: I | Elective Compulsory | | |

| Course L0454: Fluid Mechan | ics |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Thomas Rung |
| Language | DE/EN |
| Cycle | SoSe |
| Content | continuum physics definition of fluids, difference to solids/structures and material properties of fluids dimensional analysis and similitude fluid forces and fluid statics transport and conservation of mass, momentum & energy fluid kinematics technically relevant flow models for incompressible fluids control volume & stream tube analysis vortical flow models potential flows boundary layer flows different types of conservation equations and their realm (Navier-Stokes/Euler/Bernoulli equations) analytical solutions for Navier-Stokes systems Analysis of internal flows (channels, pipes, open channels) and external flows, fundamentals of wing aerodynamics turbulent flows fundamentals of gas dynamics (1D compressible flows) |
| Literature | the course primarily refers to / das Modul stütz sich bevorzugt auf : Munson, B.R.; Rothmayer, A.P.; Okiishi, T.H.; Huebsch, W.W.: Fundamentals of Fluid Mechanics, John Wiley & Sons. Spurk, J.; Aksel, N.: Strömungslehre, Springer. Schade, H.; Kunz, E., Kameier, F.; Paschereit, C.O.: Strömungslehere, De Gruyter. Herwig, H.: Strömungsmechanik, Springer. Herwig, H.: Strömungsmechanik von A-Z, Vieweg. |

| Course L0455: Fluid Mechani | ourse L0455: Fluid Mechanics | |
|-----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Thomas Rung | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|-----------------------------------|---|--|---------------------|------------|
| Title | | Тур | Hrs/wk | СР |
| Ship Dynamics (L0352) | | Lecture | 2 | 3 |
| Ship Dynamics (L1620) | | Recitation Section (small) | 1 | 1 |
| | in Naval Architecure and Ocean Engineering (L0364) | Lecture | 2 | 3 |
| | Prof. Moustafa Abdel-Maksoud | | | |
| | None | | | |
| Recommended Previous Knowledge | Technical mechanicsLinear algebra, analysis, complex numbersFluid mechanics | | | |
| Educational Objectives | After taking part successfully, students have reached t | he following learning results | | |
| Professional Competence | | | | |
| Knowledge | - The students are able to give an overview over various manoeuvres. They can name application goals and they can describe t procedure of the manoeuvres. | | | |
| | - The students are able to give an overview over varius | rudder types. They can name criteria | n the rudder des | ign. |
| | - The students can name computation methods which a | are used to determine forces and motic | ns in waves. | |
| Skills | Skills - The students can come up with the equations of motions which are used to discribe manoeuvres. The can use and lir - The students are able to determine hydrodynamic coefficients and they can explain their physical meaning. | | e and linearise the | |
| | - The students can explain how a rudder works and the | y can explain the physical effects whic | h can occur. | |
| | - The students can mathematically describe waves. | | | |
| | - The students can explain the mathematically descript | ion of harmoncial motions in waves an | d they can deter | mine them. |
| Personal Competence | | | | |
| Social Competence | - The students can arrive at work results in groups and | document them. | | |
| | - The students can discuss in groups and explain their | point of view. | | |
| Autonomy | - The students can assess their own strengthes and we | aknesses and the define further work s | teps on this basi | s. |
| Workload in Hours | Independent Study Time 140, Study Time in Lecture 70 |) | | |
| Credit points | 7 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 180 min | | | |
| | General Engineering Science (German program, 7 sem | ester): Specialisation Naval Architectur | e: Compulson/ | |
| Following Curricula | General Engineering Science (English program, 7 seme | • | | |
| shing carricula | Naval Architecture: Core Qualification: Compulsory | , specialisation naval Architecture | | |

| Course L0352: Ship Dynamic | S |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 |
| | |
| Literature | |
| | Abdel-Maksoud, M., Schiffsdynamik, Vorlesungsskript, Institut f ür Fluiddynamik und Schiffstheorie, Technische Universit ät |
| | Hamburg-Harburg, 2014 |
| | Abdel-Maksoud, M., Ship Dynamics, Lecture notes, Institute for Fluid Dynamic and Ship 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. Berlin Heidelberg, Deutschland, 1992 |
| | Faltinsen, O. M., Sea Loads on Ships and Offshore Structures, Cambridge University Press, 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 Controllability, Society of Naval Architects and |
| | Marine Engineers, Jersey City, NJ, 1989 |
| | Lewandowski, E. M., The Dynamics of Marine Craft: Maneuvering and Seakeeping, World Scientific, USA, 2004 |
| | Lloyd, A., Ship Behaviour in Rough Weather, Gosport, Chichester, Sussex, United Kingdom, 1998 |
| | |
| | <u> </u> |

| Course L1620: Ship Dynamic | urse L1620: Ship Dynamics | |
|----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| CP | 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 | |

| Tvp | Lecture |
|-------------------|--|
| Hrs/wk | |
| | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Dr. Sven Wassermann |
| 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 | | αγΤ | Hrs/wk | СР |
| Ship Structural Design (L0412) | | Lecture | 2 | 3 |
| Ship Structural Design (L0415) | | Recitation Section (small) | 2 | 3 |
| Welding Technology (L1123) | | Lecture | 3 | 3 |
| Module Responsible | Prof. Sören Ehlers | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mechanics I - III | | | |
| Knowledge | Fundamentals of Materials Science I - III | | | |
| | Welding Technology I | | | |
| | Fundamentals of Mechanical Design I - I | I | | |
| Educational Objectives | After taking part successfully, students | nave reached the following learning results | | |
| Professional Competence | | | | |
| - | | ng as well as fabrication of the different areas of ship | o structures and o | f different ship typ |
| 5 | | alculation models for complex structures. | | |
| | | on models and to assess the chosen structure | | |
| Personal Competence | | | | |
| Social Competence | Students are capable to present their st | ructural design and discuss their decisions construction | ively in a group. | |
| | Students are capable to design indepe | ndently different structural areas of the ship hull a | and different ship | types and to def |
| Autonomy | | | | cypes and co act |
| Autonomy | appropriate fabrication methods. | | | |
| Autonomy | appropriate fabrication methods. | | | |
| Autonomy Workload in Hours | | ie in Lecture 98 | | |
| Workload in Hours Credit points | Independent Study Time 172, Study Tim | ie in Lecture 98 | | |
| Workload in Hours Credit points Course achievement | Independent Study Time 172, Study Time 9 None | e in Lecture 98 | | |
| Workload in Hours Credit points Course achievement Examination | Independent Study Time 172, Study Time 9 None Written exam | e in Lecture 98 | | |
| Workload in Hours Credit points Course achievement Examination Examination duration and | Independent Study Time 172, Study Time 9 None Written exam 3 hours | ie in Lecture 98 | | |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale | Independent Study Time 172, Study Time 9 None Written exam 3 hours | | | |
| Workload in Hours Credit points Course achievement Examination Examination duration and | Independent Study Time 172, Study Time 9 None Written exam 3 hours General Engineering Science (German p | ie in Lecture 98 rogram, 7 semester): Specialisation Naval Architectu ogram, 7 semester): Specialisation Naval Architectur | | |

| Course L0412: Ship Structural Design | | |
|--------------------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| CP | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Sören Ehlers | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Chapters: | |
| | Bulkheads and tanks Structural design of forebodies Structures in engine rooms Aft bodies and rudders Detail structural design Outfitting Bulk carriers Tankers Container ships Production-kind steel structural design Buckling and ultimate strength Safety factors and reliability of structures | |
| Literature | Vorlesungsskript mit weiteren Literaturangaben wird über das Internet verfügbar gemacht | |

| Hrs/wk 2 Q 3 Workload in Hours Independent Study Time 62, Study Time in Lecture 28 Lecture For. Sören Ehlers Language DE 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 10. Production-kind steel structural design 10. Production-kind steel structural design | Тур | Recitation Section (small) |
|---|-------------------|---|
| 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. Structural design of forebodies 3. Structural design of forebodies 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 10. Production-kind steel structural design | Hrs/wk | 2 |
| 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 | CP | 3 |
| Language DE Cycle SoSe Content Chapters: 1. Bulkheads and tanks 2. Structural design of forebodies 3. Structures in engine rooms 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 | Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Cycle SoSe Content Chapters: 1. Bulkheads and tanks 2. Structural design of forebodies 3. Structures in engine rooms 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 | Lecturer | Prof. Sören Ehlers |
| 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 | Language | DE |
| Bulkheads and tanks Structural design of forebodies Structures in engine rooms Aft bodies and rudders Detail structural design Outfitting Bulk carriers Tankers Container ships Production-kind steel structural design Buckling and ultimate strength | Cycle | SoSe |
| Structural design of forebodies Structures in engine rooms Aft bodies and rudders Detail structural design Outfitting Bulk carriers Tankers Container ships Production-kind steel structural design Buckling and ultimate strength | Content | Chapters: |
| 12. Safety factors and reliability of structures | | Structural design of forebodies Structures in engine rooms Aft bodies and rudders Detail structural design Outfitting Bulk carriers Tankers Container ships Production-kind steel structural design |

| Course L1123: Welding Tech | nology |
|----------------------------|---|
| 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 | |
| Cycle | |
| Content | 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 |
| | - 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 |
| | |
| Literature | 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. |
| | 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. |
| | |

| Courses | | | | |
|------------------------------------|--|---|-------------------|---------------------|
| Title | | Typ | Hrs/wk | СР |
| Fundamentals of Ship Structural De | sign (10411) | Typ Lecture | 2 | 2 |
| Fundamentals of Ship Structural De | - | Recitation Section (small) | 1 | 2 |
| Fundamentals of Ship Structural Ar | - | Lecture | 2 | 2 |
| Fundamentals of Ship Structural Ar | | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Sören Ehlers | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mechanics I - III | | | |
| Knowledge | Fundamentals of Materials Science I - III | | | |
| | Welding Technology I | | | |
| | Fundamentals of Mechanical Design I - III | | | |
| | | | | |
| | | | | |
| Educational Objectives | After taking part successfully, students have re | eached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students can reproduce the basic contents of t | he structural behaviour of ship structures; the | y can explain the | theory and metho |
| | for the calculation of deformations and stresse | s in beam-like structures. | | |
| | | | | |
| | Furthermore, they can reproduce the basis co | ntents of codes (rules), materials, semi-finish | ed products, join | ing and principles |
| | structural design of components in the ship str | ucture. | | |
| | | | | |
| | | | | |
| Skills | Students are capable of applying the method | ds and tools for the calculation of linear def | ormations and s | tresses in the abo |
| | mentioned structures; they can choose calcula | tion models of typical ship structures. | | |
| | | | | |
| | Furthermore, they are capable to apply the m | ethods of drawing and sizing the ship structu | re; they can sele | ct suitable materia |
| | semi-finished products and joints. | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | The students are able to communicate and c | ooperate in a professional environment in th | e shipbuilding ar | id component sup |
| | industry. | | | |
| Autonomy | The students are capable to independently id | ealize real ship structures and to select suita | ble methods for | analvsis of beam-li |
| 2 | structures; they are capable to assess the resu | | | , |
| | | , , , , , , , , , , , , , , , , , , , | | |
| | Furthermore, they are capable to assess d | rawings of complex ship structures and to | design ship st | ructures for vario |
| | requirements and boundary conditions. | | | |
| | | | | |
| | | | | |
| Workload in Hours | Independent Study Time 156, Study Time in Lecture 84 | | | |
| Credit points | 8 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 3 hours | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program | n, 7 semester): Specialisation Naval Architectu | re: Compulsory | |
| Following Curricula | General Engineering Science (English program | | 1 | |
| | Naval Architecture: Core Qualification: Comput | | | |

| Course L0411: Fundamentals | s 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 | |
| CP | 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 |
| CP | 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 |

| ourse L0414: Fundamentals of Ship Structural Analysis | |
|---|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| CP | 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 |

| Courses | | | | |
|-----------------------------------|---|---|--------------------|----------------------|
| Title | | Тур | Hrs/wk | СР |
| Resistance and Propulsion (L1265) | | Lecture | 2 | 3 |
| Resistance and Propulsion (L1266) | | Recitation Section (large) | 2 | 3 |
| Module Responsible | Prof. Stefan Krüger | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mechanics | | | |
| Knowledge | Fluid Dynamics for Naval Architects | | | |
| | Hydrostratics | | | |
| | | | | |
| Educational Objectives | After taking part successfully, students have reach | ed the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The hydrodynamic basics that are relevant for | | | |
| | phenomena and their practical applications to hull | - | | |
| | of the course. Furthermore, environmental additio | | | |
| | their application to full scale ships. This hold also | | - | |
| | Main Focus is how hull forms can be optimized for i | minimum and sustainable fuel consumption | . The following to | opics are dealt with |
| | - Stillwater/added resistance, Wave resistance, M | Ainimization of wave resistance, numerication | al prediction me | thods, friction law |
| | laminar/turbulent flow separation, Hull form desi | gn for redcude flow separation, Appenda | ge Design and | resistance, Froude |
| | resistance law,form factor method, thrust deduction | on, wake, model scaling laws, resistance t | ests, free running | g propeller tests a |
| | 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 competitve hull f | forms with respect to fuel consumption by | applying numreic | al techniques and |
| Skiils | evaluate these hulls by several progosis metho | | | |
| | minimize the required power including environmen | | | |
| | | | | |
| Personal Competence | | | | |
| | The student learns to prepare technical matters in | | - | |
| Autonomy | The student learns to prepare technical matters in | such a way that he can compte with his bu | ilding suvervisior | i team. |
| Workload in Hours | Independent Study Time 124, Study Time in Lectur | re 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 180 min | | | |
| scale | | | | |
| | | anneater). Createlization Neural Architectur | Commulaon, | |
| Assignment for the | General Engineering Science (German program, 7 s | semester): Specialisation Naval Architectur | e: compulsory | |

| Course L1265: Resistance and Propulsion | |
|---|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Stefan Krüger |
| Language | DE |
| Cycle | WiSe |
| Content | |
| Literature | |

| ourse L1266: Resistance and Propulsion | |
|--|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| CP | 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 |

| itle | | | | |
|-----------------------------|---|---|--|--|
| | | Тур | Hrs/wk | CP |
| nip Design (L1262) | | Lecture | 2 | 3 |
| nip Design (L1264) | | Recitation Section (large) | 2 | 3 |
| Module Responsible | Prof. Stefan Krüger | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | Fluid Dynamics for Naval Architects, Resistant Resistance and Propulsion, Hydrostatics | nce and Propulsion | | |
| Educational Objectives | After taking part successfully, students have reache | ed the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The lecture starts with an overview about the imp Ship Designs are thoroughly discussed. Typical bulk main parameters of a ship are introduced and th influence of alternated main parameters on the to lecture, the design changes are dealt with by si systems properly so that the relavent technical con The lecture continues with an introduction into the contract. Further, methods are introduced to gene during the different design stages. In detail, the foll - Structure of a building specification - Determination of Light Ship Weight and Deadweig Components - Design of main section and hull form - Design of main propulsion plant - Design of subdivision - Determination of limiting GMrequ- Curves - Scantlings of most improtant structural members - Longitudinal strength - Outfitting Components | ding contracts and the related technical ris eir influence on the competitiveness of a tal performance of a ship design and the of mple models or formulae. The student s clusions can be drawn. e different phases of design project, from rate bulding specfication relevant informa lowing topics are adressed: | k are introduced. design. The lect consecutive proc shall further learn the initial design | The most importa ture focusses on t ess elements. In t in to model compl n phase to a buildi |
| | - Relevant rules and regulations | | | |
| Skills | The student is made familiar with the basic design student shall be able to carry out a concept design the Marine Environment. The lecture deals with the of a ship design with respect to fulfillment procedure relevant methods to determine and judge uppn the | based on a vessel of comparison fulfilling e basic design methods to determine the irres of the contract values. Based on the l | y typical contract fundamantal tech ecture "Principles | requirements with hnical characterist |
| Personal Competence | | | | |
| Social Competence | The students learns to prepare technical matte | rs in such a way the he can persuade | his potantial c | ustomer against |
| Autonomy | competitors. The students learns to prepare technical matter competitors. | rs in such a way the he can persuade | his potantial c | ustomer against |
| Workload in Hours | Independent Study Time 124, Study Time in Lectur | e 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 180 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 s | semester): Specialisation Naval Architectur | e: Compulsory | |
| Following Curricula | General Engineering Science (English program, 7 se Naval Architecture: Core Qualification: Compulsory | emester): Specialisation Naval Architecture | e: Compulsory | |

| 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 | ourse L1264: Ship Design | |
|---------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| CP | 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 crosssectional 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.

| Module M0886: Funda | amentals of Proc | ess Engineering | and Material Engineering | | |
|--|---|------------------------------|--|--------------------------|---------------------|
| Courses | | | | | |
| Title | | | Тур | Hrs/wk | СР |
| Introduction into Process Engineeri | | (L0829) | Lecture | 2 | 1 |
| Fundamentals of material engineer | | | Lecture | 2 | 2 |
| • | | | | | |
| Admission Requirements | | | | | |
| Recommended Previous | none | | | | |
| Knowledge | A Constalling park average | Cities at sub-onto house you | 1. The following loopping popula | | |
| Educational Objectives | After taking part succes | ssfully, students nave rea | ached the following learning results | | |
| Professional Competence | After passing this modu | le the students have the | ability to | | |
| Kiloweage | After passing this modu | lle the students have the | ability to. | | |
| | | | elds on process and bioprocess enginee ent fields in process engineering. | ring, | |
| 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 of pointers. | | | | |
| Personal Competence Social Competence | The students are able to work out results in groups and document them, provide appropriate feedback and handle feedback on their own performance constructively. | | | | |
| Autonomy Workload in Hours | Engineering and Biopro- | cess Engineering. | ss of learning by themselves and to de | liberate their lack of k | nowledge in Process |
| Credit points | 1 | e 34, Study Time in Lect | ure 56 | | |
| Course achievement | <u> </u> | Form | Description | | |
| course acmevement | | Written elaboration | | | |
| Examination | Written exam | | | | |
| Examination duration and | 90 min | | | | |
| scale | | | | | |
| Assignment for the | General Engineering Sc | ience (German program, | 7 semester): Specialisation Process Eng | ineering: Compulsory | |
| Following Curricula | General Engineering Sc | ience (German program, | 7 semester): Specialisation Bioprocess | Engineering: Compulso | ry |
| | Bioprocess Engineering | : Core Qualification: Com | npulsory | | |
| | | | 7 semester): Specialisation Bioprocess E | | у |
| | | | 7 semester): Specialisation Process Engi | neering: Compulsory | |
| | - | Core Qualification: Election | | | |
| | Process Engineering: Co | ore Qualification: Compu | Isory | | |

| Course L0829: Introduction into Process Engineering/Bioprocess Engineering | |
|--|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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: Fundamentals | | |
|----------------------------|---|--|
| | Lecture | |
| Hrs/wk | 2 | |
| CP | | |
| 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 | |
|------------------------------|---|
| Fitle | Typ Hrs/wk CP |
| Computer Engineering (L0321) | Lecture 3 4 |
| Computer Engineering (L0324) | Recitation Section (small) 1 2 |
| Module Responsible | Prof. Heiko Falk |
| | None |
| | Basic knowledge in electrical engineering |
| Knowledge | |
| Professional Competence | After taking part successfully, students have reached the following learning results |
| - | This module deals with the foundations of the functionality of computing systems. It covers the layers from the assembly-le 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 physic composition of computer systems. The students can analyze, how highly specific and individual computers can be built based of collection of few and simple components. They are able to distinguish between and to explain the different abstraction layers 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 compu- system and the software executed on it. In particular, they shall understand the consequences that the execution of software on the hardware-centric abstraction layers from the assembly language down to gates. This way, they will be enabled to evalue the impact that these low abstraction levels have on an entire system's performance and to propose feasible options. |
| Personal 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 |
| | 6 |
| Course achievement | Compulsory Bonus Form Description Yes 10 % Excercises |
| Examination | |
| | 90 minutes, contents of course and labs |
| scale | |
| Assignment for the | 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 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 Process Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatron Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechan Compulsory |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Syste Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory Concrat Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical |
| | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechan Engineering: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Product Developm and Production: Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syster |
| | |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste Compulsory |
| | Compulsory General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Syste |

| G | General Engineering Science (English program, 7 semester): Specialisation Energy and Enviromental Engineering: Compulsory |
|---|--|
| G | General Engineering Science (English program, 7 semester): Specialisation Computer Science: Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Biomechanics: |
| C | Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Energy Systems: |
| C | Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Aircraft Systems |
| E | Engineering: Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Materials in Engineering |
| S | Sciences: Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Mechatronics: |
| C | Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Product Development |
| а | and Production: Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Mechanical Engineering, Focus Theoretical Mechanical |
| E | Engineering: Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Naval Architecture: Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Process Engineering: Compulsory |
| G | General Engineering Science (English program, 7 semester): Specialisation Biomedical Engineering: Compulsory |
| 0 | Computational Science and Engineering: Core Qualification: Compulsory |
| N | Mechatronics: Core Qualification: Compulsory |
| Т | Technomathematics: Specialisation II. Informatics: Elective Compulsory |

| Course L0321: Computer Engineering | | |
|------------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| CP | 4 | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE/EN | |
| 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 Eng | ourse L0324: Computer Engineering | |
|----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Heiko Falk | |
| Language | DE/EN | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|--|---|--|--|----------------------|
| Title Fundamentals of Fluid Mechanics (I | | Typ Lecture Recitation Section (large | Hrs/wk 2 2) 2 | CP 4 2 |
| Fluid Mechanics for Process Engine Module Responsible | | Recitation Section (large | :) Z | Z |
| Admission Requirements | | | | |
| Recommended Previous | None | | | |
| Knowledge | Mathematics I+II+III Technical Mechanics I+II Technical Thermodynamics I+II Working with force balances Simplification and solving of partial Integration | differential equations | | |
| Educational Objectives | After taking part successfully, students ha | ve reached the following learning results | | |
| Professional Competence | | | | |
| | explain simplifications of the Contin | erent types of flow cations of the Reynolds Transport-Theorem in nuity- and Navier-Stokes-Equation by using ph | | ions |
| Skills | s The students are able to 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 Autonomy | are capable to gather information f of the lecture and able to work together on subject re (e.g. during small group exercises) are able to work out solutions for ex The students are able to search further literature for each to | rom subject related, professional publications elated tasks in small groups. They are able to kercises by themselves, to discuss the solution pic and to expand their knowledge with this li n and to evaluate their actual knowledge with | o present their results ns orally and to presen terature, | effectively in Engli |
| Workload in Hours | Independent Study Time 124, Study Time | in Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | CompulsoryBonusFormYes5 %Midterm | Description | | |
| Examination | | | | |
| Examination duration and scale | 3 hours | | | |
| Assignment for the | General Engineering Science (German pro | gram, 7 semester): Specialisation Process Eng | ineering: Compulsory | |
| Following Curricula | General Engineering Science (German pro General Engineering Science (German pro Bioprocess Engineering: Core Qualification Energy and Environmental Engineering: Co General Engineering Science (English prog | ore Qualification: Compulsory gram, 7 semester): Specialisation Bioprocess E gram, 7 semester): Specialisation Energy and | Enviromental Enginee nologies: Compulsory Engineering: Compulso Enviromental Engineer | ring: Compulsory |

| Course L0091: Fundamentals | of Fluid Mechanics |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. Michael Schlüter |
| Language | DE |
| Cycle | SoSe |
| 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. München, Pearson Studium, 2007 Oertl, H.: 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 |

| Course L0092: Fluid Mechani | ics for Process Engineering |
|-----------------------------|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| CP | 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 |

| Courses | | | | |
|---------------------------------|---|--|--------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Phase Equilibria Thermodynamics | | Lecture | 2 | 2 |
| Phase Equilibria Thermodynamics | | Recitation Section (small) | 1 | 2 |
| Phase Equilibria Thermodynamics | | Recitation Section (large) | 1 | Z |
| Module Responsible | | | | |
| Admission Requirements | None | | | |
| | Mathematics, Physical Chemistry, Thermoo | lynamics I and II | | |
| Knowledge | | | | |
| Educational Objections | | | | |
| | After taking part successfully, students have | ve reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | • Starting from the very basics of th | ermodynamics, the students learn the mathemati | cal tools to desc | ribe thermodyna |
| | equilibria. | | | |
| | They learn how state variables are | influenced by the mixing of compounds and learn | n concepts to qu | antitatively desc |
| | these properties. | | | |
| | Moreover, the students learn how | phase equilibria can be described mathematically | and which phen | omena may occu |
| | different phases (vapor, liquid, solid |) coexist in equilibrium. Furthermore the fundamen | tals of reaction e | quilibria are taug |
| | For different phase equilibria, seven | eral examples relevant for different kinds of proc | esses are showr | and the necess |
| | knowledge for plotting and interpret | ing the equilibria are taught. | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Skills | Applying their knowledge, the stud | ents are able to identify the correct equation for | the determination | on of the equilibr |
| | Applying their knowledge, the students are able to identify the correct equation for the determination of the equilibrius state and know how to simplify these equations meaningfully. | | | |
| | | an be used to determine the properties of the syst | em in the equilit | orium state and t |
| | are able to solve the resulting math | | | |
| | • For specific applications, they are a | ble to self-reliantly find necessary physico-chemica | I properties of co | ompounds as wel |
| | model parameters in literature source | ces. | | |
| | Beside pure compound properties the second properties the second properties of the second p | ne students are capable of describing the properties | of mixtures. | |
| | The students know how to visualize | phase equilibria graphically and they know how to | nterpret the occ | urring phenomen |
| | Based on their knowledge, the st | udents are able to understand fundamental cor | cepts that are | the basis for m |
| | separation and reaction processes in | n chemical engineering. | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | The students are able to work in small gro | pups, to solve the corresponding problems and to | present them or | aly to the tutors |
| | other students | | | |
| Autonomy | The students are able to find necess | ary information self-reliantly in literature sources a | nd to judge their | quality |
| | | are able to check their learning progress conti | | |
| | knowledge the students can adept t | | nuousiy in exert | bused. Bused off |
| | | | | |
| | | | | |
| | | | | |
| | Independent Study Time 124, Study Time | in Lecture 56 | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | | | | |
| Examination duration and | 120 minutes; theoretical questions and cal | culations | | |
| scale | | | | |
| - | | gram, 7 semester): Specialisation Process Engineeri | | |
| Following Curricula | | gram, 7 semester): Specialisation Bioprocess Engine | eering: Compulso | vry |
| | Bioprocess Engineering: Core Qualification | | | |
| | | ram, 7 semester): Specialisation Bioprocess Engine | | ý |
| | General Engineering Science (English prog Process Engineering: Core Qualification: Co | ram, 7 semester): Specialisation Process Engineerir | ig: Compulsory | |
| | | | | |

| Course L0140: Phase Equilib | oria Thermodynamics |
|-----------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | (1 |
| CP | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | r Prof. Irina Smirnova |
| Language |) DE |
| Cycle | a 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: 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 L0142: Phase Equilib | ria Thermodynamics |
|-----------------------------|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| CP | 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: eaction 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. |

| C | | | | |
|---|--|---|---|---------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Bioprocess Engineering - Fundamentals (L0841) Bioprocess Engineering- Fundamentals (L0842) | | Lecture Recitation Section (large) | 2 | 3 1 |
| Bioprocess Engineering - Fundamental Practical Course (L0843) | | Practical Course | 2 | 2 |
| | | | L | L |
| Module Responsible | | | | |
| Admission Requirements | | | | |
| Recommended Previous | none, module "organic chemistry", module | "fundamentals for process engineering" | | |
| Knowledge | | | | |
| Professional Competence | After taking part successfully, students have | e reached the following learning results | | |
| | enzymes and microorganisms, as well as rheology can be named and mass transp | students should be able to | The parameters of d. The students are | of stoichiometry a |
| | predict qualitatively the influence of fermentation process analyze bioprocesses on basis of stoi distinguish between scale-up criteria to compare them as well as to apply propose solutions to complicated biol to explore new knowledge resources identify scientific problems with concerning | for growth and substrate-uptake and to calcula f energy generation, regeneration of redox ec- chiometry and to set up / solve metabolic flux e for different bioreactors and bioprocesses (and them to current biotechnical problem technological problems and to deduce the corre and to apply the newly gained contents rete industrial use and to formulate solutions. dures as well as results in a scientific manner | quivalents and grow equations aerobic, aerobic as a | wth inhibition on t |
| | take position to their own opinions and incre | s should be able to debate technical questions ease their capacity for teamwork in engineering s will be able to solve a technical problem in a lenum. | and scientific envi | ronments. |
| Workload in Hours | Independent Study Time 96, Study Time in | Lecture 84 | | |
| workload in Hours | | | | |
| Credit neinte | | Description | | |
| Credit points | Compulsory Bonus Form | Description | | |
| Credit points Course achievement | Yes 5 % Subject theoretica | | | |
| | | | | |
| Course achievement | Yes 5 % Subject theoretica | | | |
| Course achievement Examination | Yes 5 % Subject theoretica practical work | | | |
| Course achievement Examination Examination duration and | Yes 5 % Subject theoretica practical work Written exam 90 min | | eering: Compulsory | |
| Course achievement Examination Examination duration and scale Assignment for the | Yes 5 % Subject theoretica practical work Written exam 90 min General Engineering Science (German progr | al and | | pry |
| Course achievement Examination Examination duration and scale Assignment for the | Yes 5 % Subject theoretica practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: | al and ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory | gineering: Compulso | - |
| Course achievement Examination Examination duration and scale Assignment for the | Yes 5 % Subject theoretica practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progra | al and ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Eng | gineering: Compulso | - |
| Course achievement Examination Examination duration and scale Assignment for the | Yes 5 % Subject theoretica practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progra General Engineering Science (English progra | al and ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Eng am, 7 semester): Specialisation Process Engine | gineering: Compulso ineering: Compulso ering: Compulsory | - |
| Course achievement Examination Examination duration and scale Assignment for the | Yes 5 % Subject theoretica practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progr General Engineering Science (English progr Biomedical Engineering: Specialisation Artifi | al and ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Eng am, 7 semester): Specialisation Process Engine icial Organs and Regenerative Medicine: Compu | gineering: Compulso ineering: Compulso ering: Compulsory Ilsory | - |
| Course achievement Examination Examination duration and scale Assignment for the | Yes 5 % Subject theoretica practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progr General Engineering Science (English progr Biomedical Engineering: Specialisation Artifi Biomedical Engineering: Specialisation Impl | al and ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Eng am, 7 semester): Specialisation Process Engine icial Organs and Regenerative Medicine: Compu ants and Endoprostheses: Elective Compulsory | gineering: Compulso ineering: Compulso ering: Compulsory ulsory | - |
| Course achievement Examination Examination duration and scale Assignment for the | Yes 5 % Subject theoretica practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progr General Engineering Science (English progr Biomedical Engineering: Specialisation Artifi Biomedical Engineering: Specialisation Impl Biomedical Engineering: Specialisation Medi | al and ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Eng am, 7 semester): Specialisation Process Engine icial Organs and Regenerative Medicine: Compu lants and Endoprostheses: Elective Compulsory ical Technology and Control Theory: Elective Com | gineering: Compulso ineering: Compulso ering: Compulsory ulsory impulsory | - |
| Course achievement Examination Examination duration and scale Assignment for the | Yes 5 % Subject theoretica practical work Written exam 90 min General Engineering Science (German progr General Engineering Science (German progr Bioprocess Engineering: Core Qualification: General Engineering Science (English progr General Engineering Science (English progr Biomedical Engineering: Specialisation Artifi Biomedical Engineering: Specialisation Impl Biomedical Engineering: Specialisation Medi | al and ram, 7 semester): Specialisation Process Engine ram, 7 semester): Specialisation Bioprocess Eng Compulsory am, 7 semester): Specialisation Bioprocess Eng am, 7 semester): Specialisation Process Engine icial Organs and Regenerative Medicine: Compu lants and Endoprostheses: Elective Compulsory ical Technology and Control Theory: Elective Co agement and Business Administration: Elective | gineering: Compulso ineering: Compulso ering: Compulsory ulsory impulsory | - |

| Course L0841: Bioprocess En | gineering - Fundamentals |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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) 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) |
| | 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 | 1. Introduction (Prof. Liese, Prof. Zeng) | |
| | 2. Enzymatic kinetics (Prof. Liese) | |
| | 3. Stoichiometry I + II (Prof. Liese) | |
| | 4. Microbial Kinetics I+II (Prof. Zeng) | |
| | 5. Rheology (Prof. Liese) | |
| | 6. Mass transfer in bioprocess (Prof. Zeng) | |
| | 7. Continuous culture (Chemostat) (Prof. Zeng) | |
| | 8. Sterilisation (Prof. Zeng) | |
| | 9. Downstream processing (Prof. Liese) | |
| | 10. Repetition (Reserve) (Prof. Liese, Prof. Zeng) | |
| Literature | siehe Vorlesung | |

| Course L0843: Bioprocess En | 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 | | | | |
|-----------------------------------|--|--|--------------------|-------------------|
| Гitle | | Тур | Hrs/wk | СР |
| Power Industry (L0316) | | Lecture | 1 | 1 |
| Energy Systems and Energy Industr | ry (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 | none | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students ha | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | With completion of this module, the stud | lents can provide an overview of characteristics | of energy systems | s and their econo |
| | distribution and power trading wih reg | curring in this context. Furthermore, they can exp ard to subject-related contexts. The students of eneral, especially for renewable energy systems al benefits from the use of such systems. | can explain these | aspects, which |
| Skills | Students are able to apply methodologies for detailed determination of energy demand or energy production for various type energy systems. Furthermore, they can evaluate energy systems technically, environmentally and economically and design t under certain given conditions. Therefore, they can choose the necessary subject-specific calculation rules, also for standardized solutions of a problem. The students are able to explain questions and possible approaches to its processing from the field of renewable energies o | | | |
| Personal Competence | and to put them them into the right conte | AL. | | |
| | The students are able to analyze suitabl | le technical alternatives and to assess them wit | h technical econo | mical and ecolor |
| | | allows them to make an effective contribuition to | | |
| | | | | poner supprj. |
| Autonomy | Students can independently exploit sour | ces , acquire the particular knowledge about the | e subject area and | I transform it to |
| | questions. | | | |
| | | | | |
| | Independent Study Time 96, Study Time in | n Lecture 84 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 3 hours written exam | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German pro | gram, 7 semester): Specialisation Energy and Env | viromental Enginee | ring: Compulsory |
| Following Curricula | General Engineering Science (German pro | gram, 7 semester): Specialisation Process Engine | ering: Compulsory | |
| - | General Engineering Science (German p | program, 7 semester): Specialisation Mechanica | Engineering, Foo | us Energy Syste |
| | Elective Compulsory | | 5 5. | 5,7 , |
| | | program, 7 semester): Specialisation Mechanica | l Engineering Foo | us Energy Syste |
| | | sogram, 7 semestery. Specialisation Mechanica | i Engineering, Fut | as Energy Syste |
| | Compulsory | deligation Chill Frazingeric Station Chill | | |
| | | cialisation Civil Engineering: Elective Compulsory | | |
| | | cialisation Traffic and Mobility: Elective Compulso | - | |
| | Civil- and Environmental Engineering: Spe | ecialisation Water and Environment: Elective Comp | oulsory | |
| | Energy and Environmental Engineering: C | ore Qualification: Compulsory | | |
| | General Engineering Science (English prog | gram, 7 semester): Specialisation Energy and Envi | romental Engineer | ring: Compulsory |
| | General Engineering Science (English p | rogram, 7 semester): Specialisation Mechanical | Engineering, Foc | us Energy Syste |
| | | | | |
| | | | | |
| | Elective Compulsory | gram, 7 semester): Specialisation Process Enginee | ring: Elective Com | pulsory |

| Course L0316: Power Industr | γ |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 1 |
| CP | 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 e-mobility)) 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 electricity generation 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 |
| Literature | Folien der Vorlesung |

| Course L0315: Energy System | Course L0315: Energy Systems and Energy Industry | | |
|-----------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| CP | 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 | |
| CP | 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 - Systemtechnik, Wirtschaftlichkeit, 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: Renewable Energy | |
|--------------------------------|--|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| CP | 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 - Systemtechnik, Wirtschaftlichkeit, 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 | | Тур | Hrs/wk | СР |
| Heat and Mass Transfer (L0101) | | Lecture | 2 | 2 |
| Heat and Mass Transfer (L0102) Heat and Mass Transfer (L1868) | | Recitation Section (small) Recitation Section (large) | 1 | 2 |
| Module Responsible | Prof. Irina Smirnova | ······ (| _ | _ |
| Admission Requirements | | | | |
| | Basic knowledge: Technical Thermodynamics | | | |
| Knowledge | | | | |
| | | | | |
| Educational Objectives | After taking part successfully, students have re | ached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | | | | |
| | heat exchanger, chemical reactors). | qualitative and determining quantitative heat racterize different kinds of heat transfer mec | | |
| | | ain the physical basis for mass transfer in | detail and to de | scribe mass tran |
| | qualitative and quantitative by using suitThey are able to depict the analogy betw | veen heat- and mass transfer and to describe | complex linked p | rocesses in detail. |
| | | | | |
| Skills | The students are able to set reasonable and to balance the corresponding energy | e system boundaries for a given transport p y and mass flow, respectively. | oblem by using t | he gained knowle |
| | and to calculate the corresponding heatUsing dimensionless quantities, the studThey are able to distinguish between dif | ents can execute scaling up of technical proc ffusion, convective mass transition and mass | esses or apparatu transfer. They ca | IS. |
| | In this context, the students are capable application considering their advantages In addition, they can calculate both, stea The students are capable to connect | tus (e.g. extraction column, rectification colu to choose and design fundamental types of and disadvantages, respectively. ady-state and non-steady-state processes in p their knowledge obtained in this course find mechanics and chemical process en | heat and mass exp procedural apparat with knowlegde | tus. of other courses |
| Personal Competence Social Competence | The students are capable to work on su manner to tutors and other students. | bject-specific challenges in teams and to pro | esent the results o | orally in a reasona |
| Autonomy | • They are able to prove their level of k | te necessary information from suitable sourc cnowledge during the course with accompa this basis they can control their learning proc | nying procedure | continuously (clic |
| Workload in Hours | Independent Study Time 124, Study Time in Le | cture 56 | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | | | | |
| | 120 minutes; theoretical questions and calculat | tions | | |
| scale | • | | | |
| Assignment for the | General Engineering Science (German program | n, 7 semester): Specialisation Process Engine | ering: Compulsory | |
| Following Curricula | General Engineering Science (German program | | | |
| | General Engineering Science (German program General Engineering Science (German program | n, 7 semester): Specialisation Energy and Env | | ering: Compulsory |
| | Bioprocess Engineering: Core Qualification: Cor | | | |
| | Energy and Environmental Engineering: Core Q | | | |
| | General Engineering Science (English program, | | | - |
| | General Engineering Science (English program, | | | ring: Compulsory |
| | General Engineering Science (English program, | | ing: compulsory | |
| | | | | |
| | Green Technologies: Energy, Water, Climate: C Technomathematics: Specialisation III. Enginee | | | |

| Course L0101: Heat and Mas | s Transfer |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Irina Smirnova |
| Language | DE |
| Cycle | WiSe |
| Content | 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 |
| CP | 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 Mas | ourse L1868: Heat and Mass Transfer | |
|----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | 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 | |

| ourses | | | | |
|--|---|---|---|--|
| itle | | Тур | Hrs/wk | СР |
| hermal Separation Processes (L01 | 18) | Lecture | 2 | 2 |
| nermal Separation Processes (L01 | 19) | Recitation Section (small) | 2 | 2 |
| hermal Separation Processes (L01 | 41) | Recitation Section (large) | 1 | 1 |
| eparation Processes (L1159) | | Practical Course | 1 | 1 |
| | Prof. Irina Smirnova | | | |
| • | None | | | |
| Recommended Previous Knowledge | Recommended requirements: Thermodynamic | s III | | |
| Educational Objectives | After taking part successfully, students have re | eached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students can distinguish and destadsorption The students develop an understanding energy demand of a process, the possib They have good knowledge of designing | g for the course of concentration during a ilities of energy saving, and the selection o | separation process, of separation systems | the estimation of t |
| Skills | Using the gained knowledge the studen close the associated energy and materia The students can use different graphic theoretical stages required They can select and design a basic ty disadvantages of the process The students are capable to obtain inde tables) They can calculate continuous and discord The students are able to prove their the The students are able to discuss the the colloquium. | al balances cal methods for the designing of a separ pe of thermal separation process for a g ependently the needed material properties ontinuous processes oretical knowledge in the experimental lab eoretical background and the content of th | ration process and o iven case based on s from appropriate so work. he experimental work | define the amount the advantages a burces (diagrams a c with the teachers |
| Personal Competence Social Competence | technical problems. Other lectures such as the The students can work technical assignment | | | utorial |
| Autonomy | The students are able to carry out practical lab work in small groups and organize a functional division of labor bet them. They are able to discuss their results and to document them scientifically in a report. The students are capable to obtain the needed information from suitable sources by themselves and assess their qualit The students can proof the state of their knowledge with exam resembling assignments and in this way control learning process | | ssess their quality | |
| Workload in Hours | Independent Study Time 96, Study Time in Leo | ture 84 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 120 minutes; theoretical questions and calcula | tions | | |
| - | General Engineering Science (German progran General Engineering Science (German progran General Engineering Science (German progran Compulsory General Engineering Science (German progran Dioprocess Engineering: Core Qualification: Co Energy and Environmental Engineering: Core C General Engineering Science (English program General Engineering Science (English program General Engineering Science (English program General Engineering Science (English program | n, 7 semester): Specialisation Bioprocess E n, 7 semester): Specialisation Green Techn ram, 7 semester): Specialisation Green n, 7 semester): Specialisation Energy and E mpulsory Qualification: Elective Compulsory , 7 semester): Specialisation Bioprocess Er , 7 semester): Specialisation Energy and E | ngineering: Compulss ologies, Focus Renew Technologies, Focus Enviromental Enginee ngineering: Compulso nviromental Engineer | ory vable Energy: Elect Renewable Energ ering: Compulsory |

Process Engineering: Core Qualification: Compulsory

L

| Course L0118: Thermal Sepa | ration Processes |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Irina Smirnova |
| Language | DE |
| Cycle | |
| 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 Sepa | ration Processes |
|---------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| CP | 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 | The students work on tasks in small groups and present their results in front of all students. 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 separatio 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 L0141: Thermal Sepa | ration Processes |
|----------------------------|--|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| CP | 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 |

| e L1159: Separation Pr | |
|------------------------|---|
| Тур | Practical Course |
| Hrs/wk | |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Irina Smirnova |
| Language | DE/EN |
| Cycle | WiSe |
| - | The students work on eight different experiments in this practical course. For every one of the eight experiments, a colloquiut takes place in which the students explain and discuss the theoretical background and its translation into practice with staff an fellow students. The students work small groups with a high degree of division of labor. For every experiment, the students write a report. The receive instructions in terms of scientific writing as well as feedback on their own reports and level of scientific writing so they calincrease 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 198: Ullmann"s Enzyklopädie der Technischen Chemie |

| Module M0892: Chem | ical Reaction Engineering | | | |
|-----------------------------------|--|--|------------------|----------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Chemical Reaction Engineering (Fu | ndamentals) (L0204) | Lecture | 2 | 2 |
| Chemical Reaction Engineering (Fu | | Recitation Section (large) | 2 | 2 |
| Experimental Course Chemical Eng | ineering (Fundamentals) (L0221) | Practical Course | 2 | 2 |
| Module Responsible | Prof. Raimund Horn | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Contents of the previous modules mathematics | -III, physical chemistry, technical thermody | namics I+II as w | vell as computationa |
| Knowledge | methods for engineers. | | | |
| Educational Objectives | After taking part successfully, students have reac | hed the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are able to explain basic concepts of | of chemical reaction engineering. They are a | ble to point out | differences betweer |
| | thermodynamical and kinetical processes. The s | tudents have a strong ability to outline par | ts of isotherma | I and non-isotherma |
| | ideal reactors and to describe their properties. | | | |
| Skills | After successful completion of the module, studer | nts are able to: | | |
| | - apply different computational methods to dimer | sion isothermal and non-isothermal ideal rea | ctors, | |
| | - determine and compute stable operation points for these reactors , | | | |
| | - conduct experiments on a lab-scale pilot plants | and document these according to scientific g | uidelines. | |
| Personal Competence | | | | |
| - | After successful completition of the lab-course th | e students have a strong ability to organize | themselfes in s | mall groups to solve |
| , | issues in chemical reaction engineering. The stu | | | 2 . |
| | their teachers. | - | | |
| Autonomy | The students are able to obtain further infor | mation and assess their relevance auton | omously. Stude | nts can apply thei |
| | knowldege discretely to plan, prepare and conduc | t experiments. | - | |
| Workload in Hours | Independent Study Time 96, Study Time in Lectur | e 84 | | |
| Credit points | 6 | | | |
| Course achievement | Compulsory Bonus Form | Description | | |
| | Yes None Subject theoretical ar | nd | | |
| | practical work | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 | semester): Specialisation Process Engineeri | ng: Compulsory | |
| Following Curricula | General Engineering Science (German program, 7 | semester): Specialisation Bioprocess Engine | ering: Compulso | bry |
| | Bioprocess Engineering: Core Qualification: Comp | ulsory | | |
| | General Engineering Science (English program, 7 | semester): Specialisation Bioprocess Engine | ering: Compulso | ry |
| | General Engineering Science (English program, 7 | semester): Specialisation Process Engineerin | g: Compulsory | |
| | Green Technologies: Energy, Water, Climate: Spe | cialisation Bioresource Technology: Elective | Compulsory | |
| | Process Engineering: Core Qualification: Compulse | ory | | |

| Course L0204: Chemical Reaction Engineering (Fundamentals) | | |
|--|--|--|
| Тур | 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 | |
| Content | 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?, 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) | |

Module Manual B.Sc. "General Engineering Science (German program, 7 semester)"

| | 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 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, mole-balance 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, CST |
|------------|--|
| Literature | 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 |
| | 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 |
| | |
| | |

| Course L0244: Chemical Read | ction 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 |
| Content | 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 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, rireversible 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 reactor, 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 reactor, integration of the batch reactor mole balance for various kinetics, partial fraction decomposition, mole balance of a batch reactor, mole balance of the balance of the plug flow reactor, design of plug flow reactors for reactions with volume change and |
|------------|--|
| Literature | comparison of CSTR and PFR with respect to conversion and selectivity, mole-balance 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 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 |

| Course L0221: Experimental | Course Chemical Engineering (Fundamentals) |
|----------------------------|--|
| Тур | Practical Course |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Raimund Horn |
| 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 M1275: Enviro | onmental Tech | nology | | | |
|---|--|----------------------------|--|---------------------------|----------------------|
| | | | | | |
| Courses | | | | | |
| Title | | | Тур | Hrs/wk | CP |
| Practical Exercise Environmental Technology (L1387) | | | Practical Course Lecture | 1 2 | 1 2 |
| Environmental Technologie (L0326 | 1 | | Lecture | Z | Z |
| Module Responsible | | litt | | | |
| Admission Requirements | | | | | |
| Recommended Previous | Fundamentals of inor | ganic/organic chemistry | and biology | | |
| Knowledge | A.C | <u></u> | | | |
| | After taking part succ | cessfully, students have r | reached the following learning results | | |
| Professional Competence | | | | | |
| Knowledge | With the completion of this modul the students obtain profound knowledge of environmental technology. They are able to describ the behaviour of chemicals in the environment. Students can give an overview of scientific disciplines involved. They can expla terms and allocate them to related methods. | | | | |
| Skills | Students are able to propose appropriate management and mitigation measures for environmental problems. They are able t determine geochemical parameters and to assess the potential of pollutants to migrate and transform. The students are able t work out well founded opinions on how Environmental Technology contributes to sustainable development, and they can preser and defend these opinons in front of and against the group. | | | | |
| Personal Competence | | | | | |
| Social Competence | The students are able | e to discuss the various t | echnical and scientific tasks, both subject | -specific and multidisci | plinary. They are at |
| | to develop different a | approaches to the task as | s a group as well as to discuss their theore | etical or practical imple | mentation. |
| Autonomy | Students can indeper | ndently exploit sources a | bout of the subject, acquire the particular | knowledge and tranfer | it to new problems |
| Workload in Hours | Independent Study Ti | ime 48, Study Time in Le | cture 42 | | |
| Credit points | 3 | | | | |
| Course achievement | Compulsory Bonus | Form | Description | | |
| | Yes None | Subject theoretical | and | | |
| | | practical work | | | |
| Examination | Written exam | | | | |
| Examination duration and | 1 hour | | | | |
| scale | | | | | |
| Assignment for the | General Engineering | Science (German progra | m, 7 semester): Specialisation Process En | gineering: Elective Com | npulsory |
| Following Curricula | | | m, 7 semester): Specialisation Bioprocess | | |
| | | | m, 7 semester): Specialisation Energy and | l Enviromental Enginee | ring: Compulsory |
| | | ng: Core Qualification: El | | | |
| | 5,7 | 5 5 | Qualification: Compulsory | | |
| | | | n, 7 semester): Specialisation Bioprocess | | |
| | | | n, 7 semester): Specialisation Energy and | - | |
| | | | n, 7 semester): Specialisation Process Eng | ineering: Elective Com | puisory |
| | Process Engineering: | Core Qualification: Elect | ive 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 | Prof. Martin Kaltschmitt, Dr. Isabel Höfer | |
| Language | DE | |
| Cycle | SoSe | |
| Content | The practical course Environmental Engineering currently consists of 6 experiments, which deal with the different focal points of environmental engineering in the areas of air, water, soil, environment, biomass and noise. The following experiments are carried out for this purpose: Determination of the calorific value of biomass, soil purification, waste water treatment, noise emissions, plastic waste, biowaste. Translated with www.DeepL.com/Translator (free version) 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 | | |

| Course L0326: Environmenta | I Technologie |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Martin Kaltschmitt, Dr. Isabel Höfer |
| 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 | | | | Тур | Hrs/wk | СР |
| Practical Course Measurement Technology (L2270) | | | Practical Course | 2 | 2 | |
| Measurement Technology (L2268) | | | Lecture | 2 | 2 | |
| Physical Fundamentals of Measurement Technology (L2269) | | | Lecture | 2 | 2 | |
| Module Responsible | Prof. Alexa | Prof. Alexander Penn | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous Knowledge | | nterest, lo | gical skills, integral- | and differential calculus, basic physical conc | epts such as tempera | ture, mass, velocit |
| Educational Objectives | After takin | ig part suci | cessfully, students ha | ve reached the following learning results | | |
| Professional Competence | | | | | | |
| Knowledge | - | | | ics (theory of motion), rotation of rigid bo operature and heat, ideal gas. | odies, energy and mo | omentum, electrici |
| | | | | easurement uncertainty, basics of sensor te vel measurement, flow measurement. Usage o | | nciples, temperatu |
| | | | | calorimetry, image data acquisition, flow mea of solid concentrations, spectroscopy, error ca | | |
| Skills | Literature research, categorisation of thematical topics, analysis of an experimental test stand, preparation of test protocol, fi programming with Matlab, use of relevant laboratory measurement technology, preparation of a test protocol, execution calculations. | | | | | |
| Personal Competence | n. | | | | | |
| Social Competence | experimen | ntal stand | | ctical training and learning groups, assessme tion with persons responsible for teaching | | - |
| Autonomy | Time management of the workload, independent development of the thematic basics, personal responsibility for the provision protective equipment and work clothing, practice of presentation in front of a group, active participation in the lecture formulation of enquiries/detailed questions by using clicker. | | | | | |
| Workload in Hours | Independe | ent Study T | ime 96, Study Time i | n Lecture 84 | | |
| Credit points | 6 | | | | | |
| Course achievement | Compulsory No | Bonus 20 % | Form Excercises | Description Popup-Quizzes währen der Vorlesun | g | |
| | 14/ | am | | | | |
| Examination | written ex | | | | | |
| | | | | | | |
| Examination | 120 min | | | | | |
| Examination Examination duration and scale | 120 min | | Science (German pro | aram. 7 semester): Specialisation Process En | aineerina: Compulsory | |
| Examination Examination duration and | 120 min General Er | ngineering | | gram, 7 semester): Specialisation Process En gram, 7 semester): Specialisation Process En | | |
| Examination Examination duration and scale Assignment for the | 120 min General Er General Er | ngineering ngineering | Science (German pro | | gineering: Compulsory | |
| Examination Examination duration and scale Assignment for the | 120 min General Er General Er General Er | ngineering ngineering ngineering | Science (German pro Science (German pro | gram, 7 semester): Specialisation Process En | gineering: Compulsory Engineering: Compulso | |
| Examination Examination duration and scale Assignment for the | 120 min General Er General Er General Er General Er | ngineering ngineering ngineering ngineering | Science (German pro Science (German pro | gram, 7 semester): Specialisation Process En gram, 7 semester): Specialisation Bioprocess gram, 7 semester): Specialisation Green Tech | gineering: Compulsory Engineering: Compulso | |
| Examination Examination duration and scale Assignment for the | 120 min General Er General Er General Er Bioprocess | ngineering ngineering ngineering ngineering s Engineeri | Science (German pro Science (German pro Science (German pro ng: Core Qualification | gram, 7 semester): Specialisation Process En gram, 7 semester): Specialisation Bioprocess gram, 7 semester): Specialisation Green Tech | gineering: Compulsory Engineering: Compulso nologies: Compulsory | |
| Examination Examination duration and scale Assignment for the | 120 min General Er General Er General Er Bioprocess General Er | ngineering ngineering ngineering ngineering s Engineeri ngineering | Science (German pro Science (German pro Science (German pro ng: Core Qualificatior Science (English prog | gram, 7 semester): Specialisation Process En gram, 7 semester): Specialisation Bioprocess gram, 7 semester): Specialisation Green Tech n: Compulsory | gineering: Compulsory Engineering: Compulso nologies: Compulsory | |
| Examination Examination duration and scale Assignment for the | 120 min General Er General Er General Er Bioprocess General Er Green Tech | ngineering ngineering ngineering ngineering s Engineeri ngineering hnologies: | Science (German pro Science (German pro Science (German pro ng: Core Qualificatior Science (English prog | gram, 7 semester): Specialisation Process En- gram, 7 semester): Specialisation Bioprocess gram, 7 semester): Specialisation Green Tech n: Compulsory gram, 7 semester): Specialisation Process Eng tte: Core Qualification: Compulsory | gineering: Compulsory Engineering: Compulso nologies: Compulsory | |

| Course L2270: Practical Cour | rse Measurement Technology |
|------------------------------|---|
| Тур | Practical Course |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Alexander Penn |
| Language | DE |
| Cycle | WiSe |
| Content | In the Practical Course in Measurement Technology the theory from the lectures "Physical Fundamentals of Measurement Technology" and "Measurement Technology" will be applied in practice. In small groups students learn how to handle different measurement techniques from industry and research. During the practical course, a wide range of different measurement methods will be taught, including the use of HLPC columns for qualitative mass analysis, the determination of mass transfer coefficients using optical oxygen sensors or the evaluation of image data to obtain process parameters. The practical course also teaches how measurement data are statistically evaluated and experiments are correctly documented. |
| Literature | Hug, H.: Instrumentelle Analytik. Theorie und Praxis. Verlag Europa-Lehrmittel, Haan-Gruiten, 2015. Kamke, W.: Der Umgang mit experimentellen Daten, insbesondere Fehleranalyse, im physikalischen Anfänger-Praktikum. Eine elementare Einführung. W. Kamke, Kirchzarten [Keltenring 197], 2010. Strohrmann, G.: Messtechnik im Chemiebetrieb. Einführung in das Messen verfahrenstechnischer Größen. Oldenbourg, München, 2004. |

Module Manual B.Sc. "General Engineering Science (German program, 7 semester)"

| Тур |
|-------------------|
| Hrs/wk |
| CP |
| Workload in Hours |
| Lecturer |
| Language |
| Cycle |
| Content |
| Literature |

| Course L2269: Physical Fund | ourse L2269: Physical Fundamentals of Measurement Technology | | |
|-----------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Christian Schroer | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | | | |
| Literature | | | |

| Courses | | | | |
|---------------------------------|--|--|-------------------------------------|--|
| Title | | Тур | Hrs/wk | СР |
| Environmental Assessment (L0860 | | Lecture | 2 | 2 |
| Environmental Assessment (L1054 | | Recitation Section (small) | 1 | 1 |
| | Prof. Martin Kaltschmitt | | | |
| Admission Requirements | | | | |
| | Fundamentals of inorganic/organic chemistry and b | iology | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reache | ed the following learning results | | |
| Professional Competence | | | | |
| Knowledge | With the completion of this module the student environmental problems which might occur from p about the methodological diversity and are compet impacts. Besides the students are able to estimate difficulties with their measurement. | roduction processes, projects or construct tent in dealing with different methods and | tion measures. | They have knowled assess environmen |
| Skills | The students are able to select a suitable method for the respective case from the variety of assessment methods. Thereby the can develop suitable solutions for managing and mitigating environmental problems in a business context. They are able to car out Life Cycle Impact Assessments independently and can apply the software programs OpenLCA and the database Econver After finishing the course the students have the competence to critically judge research results or other publications environmental impacts. | | | |
| Personal Competence | | | | |
| Social Competence | The students are able to discuss the various technic to develop jointly different solutions and to discu- topics, the students receive insights into the multi- Their sensitivity and consciousness towards these social responsibilities in their role as engineers. | iss their theoretical or practical impleme layered issues of the environment protect | ntation. Due to tion and the con | the selected lectuce cept of sustainabilities |
| Autonomy | The students learn to research, process and pres scientific work. They can solve an environmental pr | | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture | 42 | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | | | | |
| Examination duration and scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 s | emester): Specialisation Process Engineer | ing: Elective Cor | npulsory |
| - | General Engineering Science (German program, 7 s General Engineering Science (German program, 7 s Bioprocess Engineering: Core Qualification: Elective | emester): Specialisation Bioprocess Engin emester): Specialisation Energy and Envir e Compulsory | eering: Elective | Compulsory |
| | Energy and Environmental Engineering: Core Qualif General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se General Engineering Science (English program, 7 se Process Engineering: Core Qualification: Elective Co | emester): Specialisation Bioprocess Engine emester): Specialisation Process Engineeri emester): Specialisation Energy and Enviro | ng: Elective Com | pulsory |

Module Manual B.Sc. "General Engineering Science (German program, 7 semester)"

| Course L0860: Environmenta | I Assessment |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 | WiSe/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: Environmenta | I Assessment |
|----------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Martin Kaltschmitt, Dr. Anne Rödl |
| Language | DE |
| Cycle | WiSe |
| 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 |
| | |

| Courses | | | | | | |
|---|---|----------------------------|----------------------------|---|------------------|--------------------|
| Title | | | | Тур | Hrs/wk | СР |
| Process and Plant Engineering I (LO | 095) | | | Lecture | 2 | 2 |
| Process and Plant Engineering I (L0096) | | | Recitation Section (large) | 1 | 2 | |
| Process and Plant Engineering I (L1 | 214) | | | Recitation Section (small) | 1 | 2 |
| Module Responsible | | iki | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | unit operation of thermal an dmechanical separation processes | | | | | |
| Knowledge | chemical reactor eing | gineering | | | | |
| Educational Objectives | After taking part succ | cessfully, students have | reached the followin | ng learning results | | |
| Professional Competence | | | | | | |
| Knowledge | students can: | | | | | |
| | classify and formulat | e blobal balance equatio | ns of chemical proce | esses | | |
| | specify linear compo | nent equations of comple | ex chemical process | es | | |
| | | sion and data reconcilliat | | | | |
| | | | ion problems | | | |
| | explain pfd-diagrams | | | | | |
| Skills | students are capable of | | | | | |
| | - formulation of mass | and energy balance equ | uations and estimati | on of product streams | | |
| | - estimation of compo | onent streams of chemic | al plants using linea | r component balance model | S | |
| | - solution of data reco | oncilliation tasks | | | | |
| | - conduction of proce | ss synthesis | | | | |
| | - economic evaluation | n of processes and the e | stimation of product | tion costs | | |
| Personal Competence | | | | | | |
| Social Competence | | | | | | |
| Autonomy | | | | | | |
| Workload in Hours | Independent Study T | ime 124, Study Time in I | ecture 56 | | | |
| Credit points | | | | | | |
| Course achievement | Compulsory Bonus | Form | Description | | | |
| | Yes 10 % | Subject theoretical | and | | | |
| | | practical work | | | | |
| Examination | Written exam | | | | | |
| Examination duration and scale | 120 Min. lectures not | es and books | | | | |
| | Concret Engineering | | na 7 aona ator). Coa | ciclication Drasses Engineer | ing. Compulson | |
| | | | | ecialisation Process Engineer ecialisation Bioprocess Engine | | |
| Following curricula | 5 | ng: Core Qualification: C | | cialisation bioprocess Engine | eening. compuise | лу |
| | | - | | cialisation Bioprocess Engine | ering: Compulso | 24 |
| | | | | | | - |
| | Compulsory | Science (English prog | iani, / semester): | Specialisation Energy and | LINITOTHERITAL E | ingineering: Elect |
| | | Science (English program | n 7 comector). Soo | cialisation Process Engineeri | na: Compulson | |
| | | | | cialisation Process Engineerii | | |
| | Process Engineering: | | | source Technology: Elective | Compuisory | |

| Course L0095: Process and P | lant Engineering I | |
|-----------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | | |
| Workload in Hours | ndependent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Mirko Skiborowski | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Introduction Structure and operation of production plants Operational business process Technical process design Motivation and targets of process development Life cycle of production plants Engineering methods and tools Mass and energy balances Strategies of process synthesis Graphical representation of processes Multidimensional regression | |

| | Data reconciliation and data validation 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) Process safety Cost estimation of production plants Production costs, capital costs, economic evaluation |
|------------|---|
| Literature | S.D. Barnicki, J.R. Fair, Ind. End. Chem., 29(1990), S. 421, Ind. End. Chem., 31(1992), S. 1679 |
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| | H.J. Lang, Chem. Eng. 55(6), 112, 1948 |
| | F. Lestak, C. Collins, Chemical Engineering, July 1997, S. 72-76 |

| Course L0096: Process and P | ourse L0096: Process and Plant Engineering I | |
|-----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Mirko Skiborowski, Dr. Thomas Waluga | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L1214: Process and P | ourse L1214: Process and Plant Engineering I | |
|-----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Mirko Skiborowski, Dr. Thomas Waluga | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| C | | | | | | |
|--|--|--|---|--|---|---------------------|
| Courses | | | | | | |
| Title | | | Тур | | Hrs/wk | СР |
| Particle Technology I (L0434) | | | Lecture | | 2 | 3 |
| Particle Technology I (L0435) Particle Technology I (L0440) | | | Practical | n Section (small) | 1 2 | 1 2 |
| | Duef Chafe a Universit | - 1- | Flactical | course | Z | Z |
| Module Responsible | | in | | | | |
| Admission Requirements Recommended Previous | | | | | | |
| Knowledge | | | | | | |
| Educational Objectives | | uccossfully, students | nave reached the following learnir | a roculto | | |
| | | iccessiony, students i | lave reached the following learnin | gresuits | | |
| Professional Competence | | mplotion of the mode | le students are able to | | | |
| Knowledge | Alter successiul co | inpletion of the modu | le students are able to | | | |
| | name and ex | xplain processes and | unit-operations of solids process | engineering, | | |
| | characterize | particles, particle dis | tributions and to discuss their bul | k properties | | |
| | | | | | | |
| | | | | | | |
| Skills | Students are able t | to | | | | |
| | | | | | | |
| | | ÷ | nd processes for solids processing | - | esired solids prop | erties of the produ |
| | | | pehavior in solids processing step | 5 | | |
| | document tr | heir work scientifically | | | | |
| Personal Competence | | | | | | |
| Social Competence | The students are a | able to discuss scier | tific topics orally with other stud | ents or scientific p | ersonal and to d | levelop solutions |
| | technical-scientific | issues in a group. | | | | |
| Autonomy | Students are able t | to analyze and solve o | uestions regarding solid particles | independently. | | |
| | | | | | | |
| Workload in Hours | | / Time 110, Study Tim | e in Lecture 70 | | | |
| | | | | | | |
| Credit points | - | Form | Description | | | |
| Credit points Course achievement | Compulsory Bonus | Form Written elaborati | Description on sechs Berichte (pro Ve | rsuch ein Bericht) à | 5-10 Seiten | |
| Course achievement | CompulsoryBonusYesNone | Form Written elaborati | • | rsuch ein Bericht) à | 5-10 Seiten | |
| Course achievement Examination | CompulsoryBonusYesNoneWritten exam | | • | rsuch ein Bericht) à | 5-10 Seiten | |
| Course achievement Examination Examination duration and | Compulsory Bonus Yes None Written exam 90 minutes | | • | rsuch ein Bericht) à | 5-10 Seiten | |
| Course achievement Examination Examination duration and scale | Compulsory Bonus Yes None Written exam 90 minutes | Written elaborati | on sechs Berichte (pro Ve | | | |
| Course achievement Examination Examination duration and scale Assignment for the | Compulsory Bonus Yes None Written exam 90 minutes General Engineerin | Written elaborati | on sechs Berichte (pro Ve | n Process Engineer | ing: Compulsory | |
| Course achievement Examination Examination duration and scale | Compulsory Bonus Yes None Written exam 90 minutes General Engineerin General Engineerin | Written elaborati ng Science (German p ng Science (German p | on sechs Berichte (pro Ve rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio | n Process Engineer n Bioprocess Engin | ing: Compulsory eering: Compulso | |
| Course achievement Examination Examination duration and scale Assignment for the | Compulsory Bonus Yes None Written exam 90 minutes General Engineerin General Engineerin General Engineerin General Engineerin | Written elaborati ng Science (German p ng Science (German p ng Science (German p | on sechs Berichte (pro Ve | n Process Engineer n Bioprocess Engin | ing: Compulsory eering: Compulso | |
| Course achievement Examination Examination duration and scale Assignment for the | Compulsory Bonus Yes None Written exam 90 minutes General Engineerin General Engineerin General Engineerin Engineerin | Written elaborati ng Science (German p ng Science (German p ng Science (German p ng Science (German p ive Compulsory | on sechs Berichte (pro Ve rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio | n Process Engineer n Bioprocess Engin on Green Technolog | ing: Compulsory eering: Compulso gies, Focus Water | and Environment |
| Course achievement Examination Examination duration and scale Assignment for the | Compulsory Bonus Yes None Written exam 90 minutes General Engineerin General Engineerin General Engineerin Engineering: Electif General Engineering: Electif General Engineering | Written elaborati ng Science (German p ng Science (German p ng Science (German p ive Compulsory ng Science (German p | on sechs Berichte (pro Ve rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio | n Process Engineer n Bioprocess Engin on Green Technolog | ing: Compulsory eering: Compulso gies, Focus Water | and Environment |
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| Course achievement Examination Examination duration and scale Assignment for the | Compulsory Bonus Yes None Written exam 90 minutes 90 minutes General Engineerin General Engineerin Engineering: Electivi General Engineering: Electivi General Engineering Electivi General Engineering: Electivi | Written elaborati ng Science (German p ng Science (German p ng Science (German p ive Compulsory ng Science (German p ering: Core Qualificati nmental Engineering: ng Science (English pr ng Science (English pr | on sechs Berichte (pro Ve rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio on: Compulsory Core Qualification: Elective Comp ogram, 7 semester): Specialisatio ogram, 7 semester): Specialisatio | on Process Engineer on Bioprocess Engin- on Green Technolog on Energy and Envir ulsory n Bioprocess Engine n Energy and Enviro | ing: Compulsory eering: Compulso gies, Focus Water omental Engineer eering: Compulsor mental Engineeri | and Environment |
| Course achievement Examination Examination duration and scale Assignment for the | Compulsory Bonus Yes None Written exam 90 minutes 90 minutes General Engineerin General Engineerin Engineering: Electiv General Engineering: Electiv General Engineerin Bioprocess Engineer Energy and Enviror General Engineering Energy and Enviror General Engineering Energineerin | Written elaborati ng Science (German p ng Science (German p ng Science (German p ive Compulsory ng Science (German p ering: Core Qualificati nmental Engineering: ng Science (English pr ng Science (English pr ng Science (English pr | on sechs Berichte (pro Ve rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio rogram, 7 semester): Specialisatio on: Compulsory Core Qualification: Elective Comp ogram, 7 semester): Specialisatio | on Process Engineer on Bioprocess Engin- on Green Technolog on Energy and Envir ulsory n Bioprocess Engine n Energy and Enviro n Process Engineerin | ing: Compulsory eering: Compulso gies, Focus Water omental Engineer eering: Compulsor mental Engineeri | and Environment |

| Course L0434: Particle Techr | nology I |
|------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 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 Tech | Course L0435: Particle Technology I | |
|-----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| CP | 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 Techr | nology I | |
|------------------------------|--|--|
| Тур | Practical Course | |
| Hrs/wk | 2 | |
| CP | 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. | |

| | Thesis |
|--|--|
| Module M-001: Bache | lor Thesis |
| | |
| Courses | |
| Title | Typ Hrs/wk CP |
| Module Responsible | Professoren der TUHH |
| Admission Requirements | According to General Regulations §21 (1): |
| | At least 126 ECTS credit points have to be achieved in study programme. The examinations board decides on exceptions. |
| | ······································ |
| Recommended Previous | |
| Knowledge Educational Objectives | After taking part successfully, students have reached the following learning results |
| Professional Competence | |
| Knowledge | The students can select, outline and, if need be, critically discuss the most important scientific fundamentals of their course of study (facts, theories, and methods). On the basis of their fundamental knowledge of their subject the students are capable in relation to a specific issue of opening up and establishing links with extended specialized expertise. The students are able to outline the state of research on a selected issue in their subject area. |
| Skills | The students can make targeted use of the basic knowledge of their subject that they have acquired in their studies to solve subject-related problems. With the aid of the methods they have learnt during their studies the students can analyze problems, make decisions on technical issues, and develop solutions. The students can take up a critical position on the findings of their own research work from a specialized perspective. |
| Personal Competence Social Competence | |
| | Both in writing and orally the students can outline a scientific issue for an expert audience accurately, understandably and in a structured way. The students can deal with issues in an expert discussion and answer them in a manner that is appropriate to the addressees. In doing so they can uphold their own assessments and viewpoints convincingly. |
| Autonomy | The students are capable of structuring an extensive work process in terms of time and of dealing with an issue within a specified time frame. The students are able to identify, open up, and connect knowledge and material necessary for 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 | |
| Course achievement | None |
| Examination | Thesis |
| Examination duration and | According to General Regulations |
| scale | |
| Assignment for the | |
| Following Curricula | General Engineering Science (German program, 7 semester): Thesis: Compulsory |
| | Civil- and Environmental Engineering: Thesis: Compulsory Bioprocess Engineering: Thesis: Compulsory |
| | Chemical and Bioprocess Engineering: Thesis: Compulsory |
| | Computer Science: Thesis: Compulsory |
| | Data Science: Thesis: Compulsory |
| | Digital Mechanical Engineering: Thesis: Compulsory |
| | Electrical Engineering: Thesis: Compulsory Energy and Environmental Engineering: Thesis: Compulsory |
| | Engineering Science: Thesis: Compulsory |
| | General Engineering Science (English program): Thesis: Compulsory |
| | General Engineering Science (English program, 7 semester): Thesis: Compulsory |
| | Green Technologies: Energy, Water, Climate: Thesis: Compulsory |
| | Computer Science in Engineering: Thesis: Compulsory Integrated Building Technology: Thesis: Compulsory |
| | Logistics and Mobility: Thesis: Compulsory |
| | Mechanical Engineering: Thesis: Compulsory |
| | Mechatronics: Thesis: Compulsory |
| | Naval Architecture: Thesis: Compulsory |
| | Technomathematics: Thesis: Compulsory Teilstudiengang Lehramt Elektrotechnik-Informationstechnik: Thesis: Compulsory |
| | Teilstudiengang Lehramt Metalltechnik: Thesis: Compulsory |
| | Process Engineering: Thesis: Compulsory |

Engineering and Management - Major in Logistics and Mobility: Thesis: Compulsory