Module Manual

Bachelor of Science (B.Sc.) Computational Science and Engineering

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| Module M1300: Software Development63Specialization II. Mathematics & Engineering Science65Module M1235: Electrical Power Systems I: Introduction to Electrical Power Systems65Module M0760: Electronic Devices68Module M0708: Electrical Engineering III: Circuit Theory and Transients70Module M0941: Combinatorial Structures and Algorithms72Module M0889: Mechanics I (Statics)74Module M0634: Introduction into Medical Technology and Systems76Module M0715: Solvers for Sparse Linear Systems78Module M0777: Semiconductor Circuit Design80Module M1269: Lab Cyber-Physical Systems82Module M0567: Theoretical Electrical Engineering I: Time-Independent Fields86Specialization III. Subject Specific Focus88Module M1433: Technical Complementary Course for Computational Science and Engineering Bachelor88Thesis89 | Module M0754: Compiler Construction | 59 |
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| Module M1235: Electrical Power Systems I: Introduction to Electrical Power Systems65Module M0760: Electronic Devices68Module M0708: Electrical Engineering III: Circuit Theory and Transients70Module M0941: Combinatorial Structures and Algorithms72Module M0889: Mechanics I (Statics)74Module M0634: Introduction into Medical Technology and Systems76Module M0715: Solvers for Sparse Linear Systems78Module M0777: Semiconductor Circuit Design80Module M1269: Lab Cyber-Physical Systems82Module M0567: Theoretical Electrical Engineering I: Time-Independent Fields86Specialization III. Subject Specific Focus88Module M1433: Technical Complementary Course for Computational Science and Engineering Bachelor88Thesis89 | Specialization II. Mathematics & Engineering Science | 65 |
| Module M0760: Electronic Devices68Module M0708: Electrical Engineering III: Circuit Theory and Transients70Module M0941: Combinatorial Structures and Algorithms72Module M0889: Mechanics I (Statics)74Module M0634: Introduction into Medical Technology and Systems76Module M0715: Solvers for Sparse Linear Systems78Module M0777: Semiconductor Circuit Design80Module M1269: Lab Cyber-Physical Systems82Module M0567: Theoretical Electrical Engineering I: Time-Independent Fields86Specialization III. Subject Specific Focus88Module M1433: Technical Complementary Course for Computational Science and Engineering Bachelor88Thesis89 | | 65 |
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| Module M0634: Introduction into Medical Technology and Systems76Module M0715: Solvers for Sparse Linear Systems78Module M0777: Semiconductor Circuit Design80Module M1269: Lab Cyber-Physical Systems82Module M0854: Mathematics IV83Module M0567: Theoretical Electrical Engineering I: Time-Independent Fields86Specialization III. Subject Specific Focus88Module M1433: Technical Complementary Course for Computational Science and Engineering Bachelor88Thesis89 | | 74 |
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| Module M0777: Semiconductor Circuit Design80Module M1269: Lab Cyber-Physical Systems82Module M0854: Mathematics IV83Module M0567: Theoretical Electrical Engineering I: Time-Independent Fields86Specialization III. Subject Specific Focus88Module M1433: Technical Complementary Course for Computational Science and Engineering Bachelor88Thesis89 | | 78 |
| Module M1269: Lab Cyber-Physical Systems82Module M0854: Mathematics IV83Module M0567: Theoretical Electrical Engineering I: Time-Independent Fields86Specialization III. Subject Specific Focus88Module M1433: Technical Complementary Course for Computational Science and Engineering Bachelor88Thesis89 | Module M0777: Semiconductor Circuit Design | 80 |
| Module M0854: Mathematics IV83Module M0567: Theoretical Electrical Engineering I: Time-Independent Fields86Specialization III. Subject Specific Focus88Module M1433: Technical Complementary Course for Computational Science and Engineering Bachelor88Thesis89 | Module M1269: Lab Cyber-Physical Systems | 82 |
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Program description

Content

Engineering disciplines utilize the results of computer science and mathematics research to an ever greater extent, both in the development of products and in the products themselves. This trend will certainly continue. New results in computer science and mathematics thus become an important innovation factor in engineering and are therefore central areas of competence for an engineer and a technical university. This has a direct impact on the objectives of the computer science and engineering course.

Engineering education benefits significantly from computer science, and computer science benefits significantly from the modeling techniques used in engineering. To be prepared for the requirements of the future, the aim of the course is to offer combined training in computer science, mathematics and engineering. This is a particularly sustainable training principle, both for industry and for research. Computer engineering opens the line between hardware and software in the light of engineering applications. Decisions as to which parts of a system should be implemented more cheaply in hardware or better with the help of flexible software can only be made and carried out on the basis of solid knowledge of both disciplines, both IT and engineering. The aim of the course is to introduce the problem and to deal with both essential aspects.

The objectives of the basic qualification are to impart knowledge, skills and competences in the fields of computer science, mathematics and engineering to the students so that new areas of knowledge and thus also new products can be developed. Choices that support student in self-determined studies in are offered in specialisation areas.

Career prospects

Successful completion of the bachelor's degree in computer science engineering at TUHH enables graduates to start a career in science, computer science engineering or a related subject, as well as an early career start in areas from trade, industry and administration (professional qualification). The graduates will then primarily work as engineers and system developers for software and hardware.

Because of their broad training, graduates are particularly requested in the job market, since the bridge between IT specialists and engineers is essential in system development. Depending on the chosen specialization, the course trains computer scientists with an engineering background or engineers with a computer science background, who find very good employment opportunities on the German and international job market largely regardless of economic trends.

Learning target

The learning objectives leading towards the described qualification are divided below into the categories knowledge, skills, social skills and independence.

Knowledge

The learned knowledge comprises facts, principles and theories in the subjects of computer science, engineering and mathematics.

- 1. Students can reproduce, define and explain known standard languages for representation used in computer science and mathematics (logic, automata theory, formal languages, graph theory, linear algebra, analysis, discrete algebraic structures, stochastics, systems theory, etc.) necessary for the formal modeling of application problems (syntax, semantics, decision problems).
- 2. Students can reproduce elementary data and index structures (vectors, matrices, relations, trees, files, pages) for sequential algorithms (also in hardware-related form) and show their advantages and disadvantages for special tasks. Students can specify algorithms to solve decision problems for formal modeling techniques. They can reproduce the basic structure of simple computing systems at different levels of abstraction in an architecture, so that you can explain how algorithms are executed on concrete systems.
- 3. The students are familiar with a whole range of classic applications of computer engineering and mathematical modeling techniques and can explain them.
- 4. Students know how problems can be broken down into smaller sub-problems (reductionist approach) and how partial results can be combined to form an overall result. Students can also describe problems that arise from error propagation and error accumulation and provide examples. Students can reproduce and justify that security, reliability, and maintenance of partial services in the event of an error (graceful degradation) can only result from concrete design decisions in an initial draft and cannot be integrated into an existing draft afterwards with reasonable effort.
- Graduates are able to explain the importance of entrepreneurial planning and goals, to analyze the organizational and personnel structures as well as the production and procurement systems of companies, to classify pricing policy and other important instruments for system development (e.g. marketing).

Technical Skills

The course of Computer Science and Engineering teaches the ability to apply learned knowledge in order to complete tasks and thus solve problems in many facets.

- Students can design and develop formal representation languages (syntax, semantics, decision problems), and they can assess and determine the
 expressiveness of the formalisms necessary for simple applications. Students can map decision problems of different formalisms onto one another
 and thus compare the expressiveness of formalisms.
- Students can examine algorithms for decision problems for completeness and correctness or convergence behavior and approximation quality, and they can demonstrate whether an algorithm is optimal or for which types of inputs the worst case occurs with regard to the runtime behavior of an algorithm.
- 3. Students can implement algorithms in programming or hardware description languages, test them and integrate them into application systems using operating systems to manage resources and use databases to manage large amounts of data. Students can demonstrate that desired states of a system are reached (controllability, accessibility) and that undesired states are never reached (safety and liveliness properties). Students can implement computer structures in hardware-related units.
- 4. Students can use formal modeling techniques for engineering applications to create, review, or evaluate simple, prototypical systems to solve problems from an application context (in terms of a simulation, as a data management system, as an application, etc.). Students can explain how models, programs and systems are automatically translated into corresponding units at a lower level of abstraction.
- 5. Students can design interfaces that allow systems to be built from modules or layers, the internals of which can be adapted without changing the interfaces. Students are able to describe design criteria, how systems can be reused and can also be used in other systems.

Social skills

The ability and the will to work with others in a goal-oriented manner, to grasp their interests and social situations, to communicate and to help shape the working and living environment is broken down as follows for the degree course in Computer Science and Engineering:

- 1. Students understand that methods of computer science and mathematics are developed across all applications and that a major achievement of the computer science engineer is on the one hand in the professional application of the methods and on the other hand in demonstrating others (clients, project partners, colleagues, ...) that a method is (in a specific sense) optimal.
- 2. Students can form teams to work in groups, define and distribute subtasks, make appointments, integrate partial solutions. They are able to communicate, interact socially and behave appropriately in the event of conflicts.
- 3. Students explain the problems described in a scientific paper and the solutions developed in the paper in a field of computer science or

mathematics, evaluate the proposed solutions in a lecture and respond to scientific questions, additions and comments.

 Students describe scientific questions in a field of computer science, engineering or mathematics and explain in a presentation an approach they have developed to solve it and respond appropriately to inquiries, additions and comments.

Competence to work independently

The ability and willingness to act independently and responsibly, to reflect on one's own actions and those of others, and also to further develop one's own ability to act, is broken down as follows into finer aspects.

- 1. The students independently evaluate the advantages and disadvantages of representation formalisms for specific tasks, compare different algorithms and data structures as well as programming languages and programming tools, and they independently select the best solution.
- 2. The graduates independently develop a small, very clearly defined scientific sub-area, can present it in a presentation and actively follow the presentations of other students, so that an interactive discourse on a scientific topic arises.
- 3. Students integrate themselves into a project context and assume responsibility for tasks in a software or hardware development project.

Program structure

The curriculum of the Bachelor's degree in Computer Science and Engineering is structured as follows. In addition to the compulsory courses from core qualification, a minimum number of credit points must be taken from each of the areas of computer science, mathematics and engineering:

- 1. Core qualification: 138 credit points
- 2. Computer science: 12 credit
- 3. Mathematics & Engineering: 6 credit points

To deepen their studies, students can choose lectures from the entire catalog of technical events at the TUHH. A total of 12 credit points must be achieved. The bachelor thesis is also rated with 12 credit points. This results in a total effort of 180 credit points.

The following four course plans describe special features of the IIW Bachelor's degree

E. Embedded systems

- 1. Core subjects in computer science
- Computer architecture
- Operating systems
- 2. Core subjects: mathematics and engineering
- Electronic components
- 3. Additional technical courses
- Semiconductor circuit technology
- Compiler construction

I. Smart grids

- 1. Core subjects in computer science
- Operating systems
- Software development
- 2. Core subjects: mathematics and engineering
- Electrical energy systems I
 Additional technical courses
- Theoretical electrical engineering I
- Electrical engineering III: network theory and transients

M. Medical systems

- 1. Core subjects in computer science
- Introduction to information security
- Software engineering
- 2. Core subjects: mathematics and engineering
- Introduction to medical technology systems
- 3. Additional technical courses
- Cyber-physical systems laboratory
 Computer architecture

C. Computational Foundations

- 1. Core subjects in computer science
- Functional programming
- Predictability and complexity
- 2. Core subjects: mathematics and engineering
- Combinatorial structures and algorithms
- 3. Additional technical courses
- Solvers for sparse linear equation systems
- Mathematics IV

Core qualification

| Module M0561: Discre | ete Algebraic Structures | | | |
|-------------------------------------|--|--|------------------|-----------------------|
| | | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Discrete Algebraic Structures (L016 | | Lecture | 2 | 3 |
| Discrete Algebraic Structures (L016 | 55) | Recitation Section (small) | 2 | 3 |
| Module Responsible | Prof. Karl-Heinz Zimmermann | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mathematics from High School. | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reache | d the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students know the important basics of discrete | e algebraic structures including elementa | ry combinatorial | structures, monoids |
| | groups, rings, fields, finite fields, and vector spaces. | They also know specific structures like se | ub sum-, and qu | otient structures and |
| | homomorphisms. | | | |
| Skills | Students are able to formalize and analyze basic dis | croto algobraic structuros | | |
| SKIIIS | Students are able to formalize and analyze basic dis | screte algebraic structures. | | |
| Personal Competence | | | | |
| Social Competence | Students are able to solve specific problems alone o | r in a group and to present the results ac | cordingly. | |
| | | | | |
| Autonomy | Students are able to acquire new knowledge from | specific standard books and to associ- | ate the acquired | knowledge to other |
| | classes. | | | |
| | | | | |
| | | | | |
| | Independent Study Time 124, Study Time in Lecture | 56 | | |
| Credit points | | | | |
| Course achievement | | | | |
| | Written exam | | | |
| Examination duration and | 120 min | | | |
| scale | | | | |
| Assignment for the | | emester): Specialisation Computer Scienc | e: Compulsory | |
| Following Curricula | Computer Science: Core qualification: Compulsory | | | |
| | Data Science: Core qualification: Compulsory | | | |
| | Computational Science and Engineering: Core qualif | | | |
| | Orientation Studies: Core qualification: Elective Corr | pulsory | | |

| Course L0164: Discrete Alge | braic 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 Alge | braic Structures |
|-----------------------------|---|
| 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 | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Module M1436: Proce | dural Programming for Compu | ter Engineers | | |
|---------------------------------|---|--|--------|----|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Procedural Programming for Comp | uter Engineers (L2163) | Lecture | 1 | 2 |
| Procedular Programming for Comp | uter Engineers (L2164) | Recitation Section (large) | 1 | 1 |
| Procedural Programming for Comp | uter Engineers (L2165) | Practical Course | 2 | 3 |
| Module Responsible | NN | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | | | | |
| Skills | | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | | | | |
| 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 min | | | |
| scale | | | | |
| Assignment for the | Computer Science: Core qualification: Comp | ulsory | | |
| Following Curricula | Data Science: Core qualification: Compulsory | ý. | | |
| | Computational Science and Engineering: Cor | e qualification: Compulsory | | |
| | Technomathematics: Core gualification: Com | lsorv | | |

| Course L2163: Procedural Pr | ogramming for Computer Engineers |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Dozenten des SD E |
| Language | DE/EN |
| Cycle | WiSe |
| Content | |
| Literature | |

| Course L2164: Procedular Pr | ogramming for Computer Engineers |
|-----------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dozenten des SD E |
| Language | DE/EN |
| Cycle | WiSe |
| Content | |
| Literature | |

| Course L2165: Procedural Pr | ogramming for Computer Engineers |
|-----------------------------|---|
| Тур | Practical Course |
| Hrs/wk | 2 |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Dozenten des SD E |
| Language | DE/EN |
| Cycle | WiSe |
| Content | |
| Literature | |

| Courses | | | | | |
|--------------------------------------|------------------------|------------------------------|-------------------------------------|--------------|----|
| Title | | | Тур | Hrs/wk | СР |
| Electrical Engineering I: Direct Cur | | | Lecture | 3 | 5 |
| Electrical Engineering I: Direct Cur | ent Networks and Elect | romagnetic Fields (L0676) | Recitation Section | on (small) 2 | 1 |
| Module Responsible | Prof. Matthias Kuhl | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | | | | | |
| Knowledge | | | | | |
| Educational Objectives | After taking part suc | cessfully, students have r | eached the following learning resu | ılts | |
| Professional Competence | | | | | |
| Knowledge | | | | | |
| Skills | | | | | |
| Personal Competence | | | | | |
| Social Competence | | | | | |
| Autonomy | | | | | |
| Workload in Hours | Independent Study 1 | Гіте 110, Study Time in L | ecture 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 program | n, 7 semester): Core qualification: | Compulsory | |
| Following Curricula | Data Science: Specia | alisation Electrical Enginee | ering: Compulsory | | |
| | 5 | g: Core qualification: Com | . , | | |
| | | | qualification: Compulsory | | |
| | | qualification: Compulsory | | | |
| | Orientation Studies: | Core qualification: Electiv | e Compulsory | | |

| Course L0675: Electrical Eng | ineering I: Direct Current Networks and Electromagnetic Fields |
|------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 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 |

| Course L0676: Electrical Eng | ineering I: Direct Current Networks and Electromagnetic Fields |
|------------------------------|--|
| 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 |

| implements these training objectives in its teaching architecture, in its teaching and learning arrangements, in teaching areas and by means of teaching offerings in which students can qualify by opting for specific competences and a competence level at the Bachelor's or Master's level. The teaching offerings are pooled in two different catalogues for nontechnic complementary courses. The Learning Architecture consists of a cross-disciplinarily study offering. The centrally designed teaching offering ensures that courses in the nontechnic 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 the subjects in the individual for the student's entire study program. | Module Responsible | Dagmar Richter |
|--|------------------------|--|
| Nonoidage Interactional Operations Extensional Competence Resolutional Resolutional Competence Resolutional Resolutional Competence Resolutional Resolutional Competence Resolutional Resolutional Competence Resolutional Resolutional Resolutional Resolutional Resolution Resolutional Resolutional Resolutional Resolution Resolutional Resolution Resolutional Resolutio | Admission Requirements | None |
| Educational Objectives Net taking part successfully, students have nached the following learning results Professional Competence Kowings The Nex-technical Academic Programms (NTA) Imparts salls that, in view of the TUNH's training profile, professional engineering studies require but are not able to cover full Self relations, californiangement, sin tacabing architecture, in to tacabing arrangements, in teaching area and the Bachelor's or Master's level. The teaching architecture, in the teaching arrangements in teaching area and the Bachelor's or Master's level. The teaching architecture, in the teaching arrangements in teaching around area area and the second's profiling of TUHH degree curses. The Learning Architecture consistent and area area and and and area independent educational planning as regards the individual development complements in the provide contradius and trains independent educational planning as regards. The individual development complements in the second's profiling of TUHH degree curses. The learning architecture demands and trains independent end or profiles" The subjects that can be studied in parallel throughain the student's entire study program. If alevel be, it can be studied in parallel throughain the student's entire study program. If alevel be, it can be studied in ages and the appendix model and the access anter adverge in the teaching architecture and are defined to addentic granupart and in order to arching in the form area and a frame architecture and area of the addent's distaged learning framed samekers abran, there is no objective study these subjects in a student's of stages of teams of the addent's and Masters and Faulting and Addention and the access semasters. The challenge of dealin with the stude(granut's use addent and stages and master and and the curses area and of the isaming architecture and are defined avea and are beached formation to a stages of teams of the addent's and Master's and | | None |
| Professional Competence Knowledge The Non-technical Academic Programms (NTA) Imparts shills that, in view of the TUHY's taining profile, professional engineering dudies require but are not able to cover full Safethance, softmanagement, collaboration and professional and personnel management competences. In the ending the technical technical academics in its backfulter academics setting and learning arrangements, in technic molements there i almost operative in its backfulter academics and particle setting and learning arrangements. In technical academic programms follow the specific profiling of TUHI degree causes. The Learning architecture consists of a cross-disciplical for profiling of TUHI degree causes. The learning architecture competences. It also provides circulation for profiling of TUHI degree causes. The subjects that can be studied in parallel through and the studied's article study program. If need be, it can be studied in one to competences. It also provides circulation for parallel models and the cause of studies. Tacademic programms follow the specific profiling of TUHI degree causes. The subjects in one or two specific structures and the cause of studies. Tacading and academic dispection parallel models and thermic dispections of studies. Tacading and academic dispection parallel models and the cause of studies. Tacading and academic dispection parallel models. Tacading and academic dispection parallel models. Tacading and academic dispection parallel studies and the studies are studies. Tacading and academic dispection causes. Fields of Tacading are based on research findings from the academic dispectives cultural studies, ards, historical studies, mogatic studies, compatient and a studies and theorem dispectives and academic dispective in the learning architecture and are defeeted and in the higher scientific academic dispectives and forming loadies, and, historical studies, mogatic studies of mosewich findings from the academic dispectives and parallel models, and data is a genetic tacked as | - | |
| Tenders The fact shells that, in we of the TUH's training polity, professional and personnel managements competencies. The department is present to the person of training polity, including an appendix and personnel management is there that marks and person of training polity, and training an appendix can apply by polity is specific competences and a competence. Image: Shell that, in we of the TUH's training polity, in the tacking article competences and a competence of the competences and a competence of the competence of th | | After taking part successfully, students have reached the following learning results |
| Imparts skills that, in view of the TUHI's training profile, professional engineering studies require but are not able to cover full series and by means of teaching offerings in which students can quality by oping for specific competences and a competence would at the Students's of Vectors in the staching and learning arrangements, in teaching and learning architecture detections in the staching offerings are pooled in two different catalogues for nontchells competenciary courses. The Learning Architecture consists of a cross-disciplinally study offering. The centrally designed teaching offering ensures that courses in the nontechnic categories in a students's and teaching dependence ducctoreal 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 entre study program - if need be, it can be studied in the transition from school to university and in order to encurse individually planning as regards the individual development competences, it was of the subjects in parallel throughout the student's entre study program - if need be, it can be studied in the transition from school to university and in order to encurse individually planned semestres abread, there is no obligation study three subjects in one or too specific semestres during the course of students. Teaching and Learning Arrangements provide for students, supparated into B.S.C., no harm with and from each other across semesters. The challenge of deal students communication studies and studiationality research, and from engineering districts. In addition, from the white sense students communication studies and studiation students and students and students and students communication studies and students in gradies with the fortune and students and students communication studies and students and there arrays the basic training districts. In addition, from the white seneed studies, communication studi | - | The Non-technical Academic Programms (NTA) |
| Selfretexture, self-management, collaboration and precisional management completency is the scheduling of the scheduling scheduling is the scheduling of the sche | | |
| consists of a cross-disciplinarily study offering. The centrality designed teaching offering ensures that courses in the nontachinal academic programms follow the specific profiling of TUH4 degree courses. The learning architecture demands and trains independent educations journing as regards the individual development competences. It also provides of refraction have degree to the student's entire study program - if need to Lano testuding to adapte to profiles. Ta subjects that can be studied in parallel throughout the student's entire study program - if need to Lano testuding to adapte to profiles that individually planned semesters after making at transition from school to subjects emesters during the course of studies. Tacching and Learning Arrangements provide for students, separated into B.S.c. no learn with and from each other across semesters. The challenge of deality with interdisciplinarity and a variety of stages of learning in courses are part of the learning architecture and are deliberate encouraging in specific courses. Fields of Taaching are based on research. Indings from the academic disciplines cultural studies, social studies, and studies, and studies, and studies, and studies, and studies and standaring in a goor oriented way. The fields of basching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging goe oriented communication skills, e.g. the skills required by outgoing engineers in international and literative programs and start-ups in a goor oriented way. The Competence (Know/deg) State oriented in the procional davater's graduates in their future working lite. Specialized opecialized areas with the relevant non-technical mother disciplines represented in the disciplines rand stater's graduates in their future working lite. Opeclasted type calleled areas students can Opeciali | | Self-reliance, self-management, collaboration and professional and personnel management competences. The department implements these training objectives in its teaching architecture , in its teaching and learning arrangements , in teachin areas and by means of teaching offerings in which students can qualify by opting for specific competences and a competence level at the Bachelor's or Master's level. The teaching offerings are pooled in two different catalogues for nontechnic |
| academic programms follow the specific profiling of TLHH degree causes. The learning architecture demands and trains independent educational planning as regards the individual development competences. It also provides orientation individuals commonly face in theri first sensities atter making the transition from school to university and in order to encourse individually planed senseties atter making the transition from school to university and in order to encourse individually planed senseties atternation that is a solution problems that individuals commonly face in theri first senseties attern making the transition from school to university and in order to encourse individually planed senseties atternation there is no obligation transition from school to university and in order to encourse individually planed senseties. The challenge of dealli with interdisciplinarity and a variety of stages of learning in courses are part of the learning architecture and are deliberate encoursed in specific courses. Fields of Tacching are based on research findings from the academic disciplines cultural studies, is social studies, arts, historical studies, many are based on research findings from the academic disciplines cultural studies. In addition, from the winter samest 2014/15 students on all Bachelor's courses will have the opportunity to learn about businest management and start-ups in a gool oriented way. The fields of traching The fields of traching are augmented by sort skills offers and a foreign language offer. Here, the focus is on encoursinging on oriented way. The fields of traching are augmented by sort skills offers and a foreign language offer. Here, the focus is an encourse offerent differences are effected in the field escarption working life. Statelist conflicted consenses: Statelist conflicted consenses: Statelist conflicted consenses: Statelist conflicted conflicted lifeteent agregates in their future working life. Statelist conflicted conflicted lifeteent cagregates in | | The Learning Architecture |
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| West semesters. In view of the adaptation problems that individuals commonly face in the first semesters after making the study these subjects in one or two specific semesters during the course of studies. It is a first individual common study these subjects in one or two specific semesters during the course of studies. It is a first individual common study these subjects in one or two specific semesters during the course or studies. It is a first individual common study these subjects in one or two specific semesters during the course or studies. It is a first individual common studies and sustainability research, and from each other across semesters. The challenge of dealing with individual common studies. In addition, from the winter semest course of individual common studies, and sustainability research, and from engineering didactics. In addition, from the winter semest course of individual courses of international and intercultural studies, communication studies or ourses will have the opportunity to learn about business management and start-ups in a goo oriented communication skills, e.g. the skills required by outgoing engineers in international and intercultural situations. It the fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging op oriented communication skills, e.g. the skills required by outgoing engineers in international and intercultural situations. It the fields of teaching are augmented by soft skills, which relate to the different professional application context and in the higher scientific and theoretical level of abstraction in the B.Sc. The Competence Level Specialized Competence (Knowledge) Stude to relate on | | 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" |
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| Social Competence Personal Competences (Social Skills) | | 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 the sum of the s |
| Social Competence Personal Competences (Social Skills) | Personal Competence | |
| Students will be able | - | Personal Competences (Social Skills) |
| | | |

Module Manual B.Sc. "Computational Science and Engineering" • 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.

| Engineering" Module M0850: Math | amatics 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) Lecture | 1 2 | 1 2 |
| Linear Algebra I (L0912) 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 | School mathematics | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reac | hed the following learning results | | |
| Professional Competence | | | | |
| Knowledge | | | | |
| | Students can name the basic concepts in | analysis and linear algebra. They are abl | e to explain the | em using appropriate |
| | examples. | | | |
| | Students can discuss logical connections b | etween these concepts. They are capable | of illustrating th | ese connections with |
| | the help of examples. | | | |
| | They know proof strategies and can reprod | uce them. | | |
| | | | | |
| | | | | |
| Skills | Students can model problems in analysis a | nd linear algebra with the help of the conce | ots studied in th | nis course. Moreover |
| | they are capable of solving them by applying | | | |
| | Students are able to discover and verify fur | | ots studied in the | course. |
| | For a given problem, the students can de | | | |
| | results. | | | includy evaluate the |
| | results. | | | |
| | | | | |
| Personal Competence | | | | |
| | | | | |
| Social Competence | Students are able to work together in team | s. They are capable to use mathematics as a | a common langu | age. |
| | In doing so, they can communicate new co | ncepts according to the needs of their coop | erating partners | . Moreover, they car |
| | design examples to check and deepen the | understanding of their peers. | | |
| | | | | |
| | | | | |
| Autonomy | | | | |
| | Students are capable of checking their und | | wn. They can sp | ecify open questions |
| | precisely and know where to get help in sol | | | |
| | Students have developed sufficient persist | tence to be able to work for longer period | s in a goal-orien | ted manner on hard |
| | problems. | | | |
| | | | | |
| | | | | |
| Workload in Hours | | ire 112 | | |
| Credit points | | | | |
| Course achievement | | | | |
| | Written exam | | | |
| Examination duration and | 60 min (Analysis I) + 60 min (Linear Algebra I) | | | |
| scale | Concrol Engineering Science (Communication | comostor), Coro suslification. Comost | | |
| - | General Engineering Science (German program, 7 Civil- and Environmental Engineering: Core qualifi | | | |
| Following Curricula | Bioprocess Engineering: Core qualification: Comp | | | |
| | Digital Mechanical Engineering: Core qualification: Compo Digital Mechanical Engineering: Core qualification | • | | |
| | Electrical Engineering: Core qualification: Computer | | | |
| | Energy and Environmental Engineering: Core qualitication: Computer | • | | |
| | Green Technologies: Energy, Water, Climate: Core | | | |
| | Computational Science and Engineering: Core qua | | | |
| | Logistics and Mobility: Core qualification: Compute | | | |
| | Mechanical Engineering: Core qualification: Computer | | | |
| | Mechatronics: Core qualification: Compulsory | ulsor y | | |
| | Orientation Studies: Core qualification: Elective Co | ompulsory | | |
| | Naval Architecture: Core qualification: Elective Co | | | |
| | Process Engineering: Core qualification: Compulso | | | |
| | | • | | |
| | Engineering and Management - Major in Logistics | and Mobility: Core qualification: Compulsory | | |

| Course L1010: Analysis I | |
|--------------------------|--|
| 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 | Foundations of differential and integrational calculus of one variable |
| | statements, sets and functions natural and real numbers convergence of sequences and series continuous and differentiable functions mean value theorems Taylor series calculus error analysis fixpoint iteration |
| Literature | http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html |

| Course L1012: Analysis I | |
|--------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| 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 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, Dr. Dennis Clemens |
| 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, Dr. Dennis Clemens |
| Language | DE |
| Cycle | WiSe |
| Content | vectors: intuition, rules, inner and cross product, lines and planes general vector spaces: subspaces, Euclidean vector spaces systems of linear equations: Gauß-elimination, matrix product, inverse matrices, transformations, LR-decomposition, block matrices, determinants |
| Literature | T. Arens u.a. : Mathematik, Spektrum Akademischer Verlag, Heidelberg 2009 W. Mackens, H. Voß: Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 W. Mackens, H. Voß: Aufgaben und Lösungen zur Mathematik I für Studierende der Ingenieurwissenschaften, HECO-Verlag, Alsdorf 1994 |

| Course L0914: Linear Algebra | rse 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, Dr. Dennis Clemens | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| identical engineering is Alternating Current Networks and Bake Devices (0.0179) Leture 3 5 Module Responsible Prof. Christian Beck# 1 Admission Requirements None 1 Recommended Pervices Electrical Engineering I 1 Professional Competence Knowledge Atter taking part succescluty, students have reached the following learning results Professional Competence Knowledge Students are abple to reproduce and explain fundamental theories, principles, and methods related to the theory of alternating currents. They can explain an averiew of applications for the theory of alternating currents in the area of electrical engineering. Students are capable of calculating parameters within simple electrical networks at alternating currents. Students are capable of calculating parameters within simple electrical networks at alternating currents. Students are able to analyze simple circuts such as accellating circuts, filter and matching network alternating currents. Students are able to work. together on subject related tasks in small groups. They are able to regrue matching network alternation o | Courses | | | | |
|---|---------------------------------------|--|---|-------------------|----------------------|
| identical engineering is Alternating Current Networks and Bake Devices (0.0179) Leture 3 5 Module Responsible Prof. Christian Beck# 1 Admission Requirements None 1 Recommended Pervices Electrical Engineering I 1 Professional Competence Knowledge Atter taking part succescluty, students have reached the following learning results Professional Competence Knowledge Students are abple to reproduce and explain fundamental theories, principles, and methods related to the theory of alternating currents. They can explain an averiew of applications for the theory of alternating currents in the area of electrical engineering. Students are capable of calculating parameters within simple electrical networks at alternating currents. Students are capable of calculating parameters within simple electrical networks at alternating currents. Students are able to analyze simple circuts such as accellating circuts, filter and matching network alternating currents. Students are able to work. together on subject related tasks in small groups. They are able to regrue matching network alternation o | Title | | Тур | Hrs/wk | CP |
| Module Responsible Prof. Christian Becker Admission Requirements None Recommended Previous Electrical Engineering I Knowledge Mathematics I Direct current networks, complex numbers Image: Complex numbers Professional Competence Students are able to reproduce and explain fundamental theories, principles, and methods related to the theory of alternative currents. They can exprove applications for the theory of alternating currents in the area of electrical engineering. Students are capable or papications for the theory of alternating currents in the area of electrical engineering. Students are capable or papications for the theory of alternating currents in the area of electrical engineering. Students are capable or papications for the theory of alternating currents in the area of electrical engineering. Students are capable or calculating parameters within simple electrical networks at alternating currents. Students are able to analyze simple circuits such as acclassing currents. Students are able to analyze simple circuits such as acclassing currents. Students are able to analyze simple circuits such as acclassing currents. Students are able to analyze simple circuits such as acclassing currents. Students are able to analyze simple circuits such as acclassing currents. They can expression of reactive power, multiphase system) and are qualified dimension elements to related to a students are able to aver. Longether on subject related tasks in small groups. They are able to parsent their results effectively. Autonomy Students are able to work logether on subject related tasks in small groups. They are able to present their results effectively. | | g Current Networks and Basic Devices (L0178) | | | |
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| Computational Science and Engineering: Core qualification: Compulsory Mechatronics: Core qualification: Compulsory | Following Curricula | | npulsory | | |
| Mechatronics: Core qualification: Compulsory | | | | | |
| | | | tion: Compulsory | | |
| Orientation Studies: Core qualification: Elective Compulsory | | | | | |

| Course L0178: Electrical Engi | ineering 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 Eng | ineering II: Alternating Current Networks and Basic Devices |
|------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Prof. Christian Becker |
| Language | DE |
| Cycle | |
| 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 |
| Automata Theory and Formal Lang Automata Theory and Formal Lang | | Lecture | on Section (small) | 2 | 4 2 |
| Module Responsible | | Necitati | on section (smail) | 2 | 2 |
| Admission Requirements | | | | | |
| | Participating students should be able to | | | | |
| Knowledge | | | | | |
| | - specify algorithms for simple data struct | ures (such as, e.g., arrays) to s | olve computational p | problems | |
| | - apply propositional logic and predicate lo | gic for specifying and understa | anding mathematical | l proofs | |
| | - apply the knowledge and skills taught in | the module Discrete Algebraic | Structures | | |
| Educational Objectives | After taking part successfully, students ha | ve reached the following learn | ing results | | |
| Professional Competence | | | | | |
| Skills | problems are hard to represent with pro syntax, semantics, and decision problem solving the predicate logic SAT decision pr kinds of temporal logic, and identify the automata and can identify relationships deterministic and nondeterministic finite formalism for which nondeterministic finite formalism for which nondeterminism is r problems require which expressivity, and, problems w.r.t. other formalisms. They un for specifying systems and their propertie or grammars. | s for this representation forma roblem. Students can also desc ir application areas. The part to logic and formal grammar e automata and pushdown au nore expressive than determi in addition, students can trans derstand that some formalisms is. Students can describe the r | alism. Students can cribe syntax, semanti ticipants of the cour: rs. The spectrum tha utomata to Turing m inism. They are also sform decision proble is easily induce algori relationships between | explain unificatio ics, and decision p se can define va at students can e nachines. Student able to demonst ems w.r.t. one forr ithms whereas ot n formalisms such | on and resolution problems for vario arious kinds of fir explain ranges fr tts can name tho trate which decis malism into decis thers are best suit n as logic, automa |
| | which formalism is best suited for a part decision problems to specific formulas. So grammars from automata and vice version | icular application problem, an udents can also transform nor | ndeterministic autom | rate the applicati nata into determin | n. They can evalu- ion of algorithms nistic ones, or der |
| | decision problems to specific formulas. Si | icular application problem, an cudents can also transform nor a. They can show how parser | ndeterministic autom | rate the applicati nata into determin | n. They can evalu- ion of algorithms nistic ones, or der |
| Personal Competence | decision problems to specific formulas. SI grammars from automata and vice versi emptiness problem in case of infinite word | icular application problem, an cudents can also transform nor a. They can show how parser | ndeterministic autom | rate the applicati nata into determin | n. They can evalu- ion of algorithms nistic ones, or der |
| | decision problems to specific formulas. SI grammars from automata and vice versi emptiness problem in case of infinite word | icular application problem, an cudents can also transform nor a. They can show how parser | ndeterministic autom | rate the applicati nata into determin | n. They can evalu- ion of algorithms nistic ones, or der |
| Personal Competence | decision problems to specific formulas. SI grammars from automata and vice versi emptiness problem in case of infinite word | icular application problem, an cudents can also transform nor a. They can show how parser | ndeterministic autom | rate the applicati nata into determin | n. They can evalu- ion of algorithms nistic ones, or der |
| Personal Competence Social Competence Autonomy | decision problems to specific formulas. SI grammars from automata and vice versi emptiness problem in case of infinite word | icular application problem, an udents can also transform nor a. They can show how parser ls. | ndeterministic autom | rate the applicati nata into determin | n. They can evalu- ion of algorithms nistic ones, or der |
| Personal Competence Social Competence Autonomy | decision problems to specific formulas. SI grammars from automata and vice vers emptiness problem in case of infinite word Independent Study Time 124, Study Time | icular application problem, an udents can also transform nor a. They can show how parser ls. | ndeterministic autom | rate the applicati nata into determin | n. They can evalu- ion of algorithms nistic ones, or der |
| Personal Competence Social Competence Autonomy Workload in Hours | decision problems to specific formulas. SI grammars from automata and vice versi- emptiness problem in case of infinite word Independent Study Time 124, Study Time 6 | icular application problem, an udents can also transform nor a. They can show how parser ls. | ndeterministic autom | rate the applicati nata into determin | n. They can evalu- ion of algorithms nistic ones, or der |
| Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement | decision problems to specific formulas. SI grammars from automata and vice versi- emptiness problem in case of infinite word Independent Study Time 124, Study Time 6 | icular application problem, an udents can also transform nor a. They can show how parser ls. | ndeterministic autom | rate the applicati nata into determin | n. They can evalu- ion of algorithms nistic ones, or der |
| Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement | decision problems to specific formulas. SI grammars from automata and vice verse emptiness problem in case of infinite word Independent Study Time 124, Study Time 6 None Written exam | icular application problem, an udents can also transform nor a. They can show how parser ls. | ndeterministic autom | rate the applicati nata into determin | n. They can evalu- ion of algorithms nistic ones, or der |
| Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement Examination | decision problems to specific formulas. SI grammars from automata and vice versi- emptiness problem in case of infinite word Independent Study Time 124, Study Time 6 None Written exam 90 min | icular application problem, an udents can also transform nor a. They can show how parser ls. | ndeterministic autom | rate the applicati nata into determin | n. They can evalu- ion of algorithms nistic ones, or der |
| Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale | decision problems to specific formulas. SI grammars from automata and vice versi- emptiness problem in case of infinite word Independent Study Time 124, Study Time 6 None Written exam 90 min | icular application problem, an udents can also transform nor a. They can show how parser is. in Lecture 56 | ndeterministic autom | rate the applicati hata into determir an apply algorithr | n. They can evalu- ion of algorithms nistic ones, or der |
| Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | decision problems to specific formulas. SI grammars from automata and vice versi- emptiness problem in case of infinite word Independent Study Time 124, Study Time 6 None Written exam 90 min | icular application problem, an- udents can also transform nor a. They can show how parser is. in Lecture 56 gram, 7 semester): Specialisat | ndeterministic autom | rate the applicati hata into determir an apply algorithr | n. They can evalu- ion of algorithms nistic ones, or der |
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| Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | decision problems to specific formulas. SI grammars from automata and vice versi- emptiness problem in case of infinite word Independent Study Time 124, Study Time 6 None Written exam 90 min General Engineering Science (German pro Computer Science: Core qualification: Com | icular application problem, an- audents can also transform nor a. They can show how parser is. in Lecture 56 gram, 7 semester): Specialisat npulsory ory | ndeterministic autom | rate the applicati hata into determir an apply algorithr | n. They can evalu- ion of algorithms nistic ones, or der |
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| Personal Competence Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | decision problems to specific formulas. SI grammars from automata and vice versi- emptiness problem in case of infinite word Independent Study Time 124, Study Time 6 None Written exam 90 min General Engineering Science (German pro Computer Science: Core qualification: Com Data Science: Core qualification: Compuls Engineering Science: Specialisation Mecha | icular application problem, an audents can also transform nor a. They can show how parser is. in Lecture 56 gram, 7 semester): Specialisat npulsory ory itronics: Elective Compulsory gram, 7 semester): Specialisatio Core qualification: Compulsory | indeterministic autom rs work, and they ca | rate the applicati hata into determin an apply algorithn e: Compulsory | n. They can evalu ion of algorithms nistic ones, or der ms for the langua |

| Course L0332: Automata The | ory and Formal Languages |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | |
| | Independent Study Time 92, Study Time in Lecture 28 |
| | Prof. Tobias Knopp |
| Language | |
| Cycle | |
| Content | |
| Content | 1. Propositional logic, Boolean algebra, propositional resolution, SAT-2KNF |
| | 2. Predicate logic, unification, predicate logic resolution |
| | 3. Temporal Logics (LTL, CTL) |
| | 4. Deterministic finite automata, definition and construction |
| | 5. Regular languages, closure properties, word problem, string matching |
| | 6. Nondeterministic automata: |
| | Rabin-Scott transformation of nondeterministic into deterministic automata |
| | 7. Epsilon automata, minimization of automata, |
| | elimination of e-edges, uniqueness of the minimal automaton (modulo renaming of states) |
| | 8. Myhill-Nerode Theorem: |
| | Correctness of the minimization procedure, equivalence classes of strings induced by automata |
| | 9. Pumping Lemma for regular languages: |
| | provision of a tool which, in some cases, can be used to show that a finite automaton principally cannot be expressive |
| | enough to solve a word problem for some given language |
| | 10. Regular expressions vs. finite automata: |
| | Equivalence of formalisms, systematic transformation of representations, reductions 11. Pushdown automata and context-free grammars: |
| | Definition of pushdown automata, definition of context-free grammars, derivations, parse trees, ambiguities, pumping |
| | lemma for context-free grammars, transformation of formalisms (from pushdown automata to context-free grammars and |
| | back) |
| | 12. Chomsky normal form |
| | 13. CYK algorithm for deciding the word problem for context-free grammrs |
| | 14. Deterministic pushdown automata |
| | 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 | itation Section (small) | |
| Hrs/wk | 2 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Tobias Knopp | |
| Language | EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| | lations of Management | | | |
|--|--|--|---|---|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Management Tutorial (L0882) Introduction to Management (L0880 | 0 | Recitation Section (small) Lecture | 2 3 | 3 3 |
| Module Responsible | | Lecture | 5 | 5 |
| Admission Requirements | | | | |
| - | Basic Knowledge of Mathematics and Business | | | |
| Knowledge | busic knowledge of Mathematics and Business | | | |
| - | After taking part successfully, students have reached the fo | blowing learning results | | |
| Professional Competence | 51 | | | |
| - | After taking this module, students know the important bas and Organisation to Marketing and Innovation, and also to | | | |
| | | | | |
| | explain the differences between Economics and important definitions from the field of Management | Management and the sub-discip | lines in Manage | ment and to nar |
| | important definitions from the field of Managementexplain the most important aspects of and goals ir | Management and name the mos | t important aspe | ts of entreprineur |
| | projects | nundgement and nume the mos | | ets of entreprired |
| | describe and explain basic business functions as | production, procurement and se | ourcing, supply | chain manageme |
| | organization and human ressource management, inf | | | - |
| | explain the relevance of planning and decision r | naking in Business, esp. in situa | tions under mul | tiple objectives a |
| | uncertainty, and explain some basic methods from r | nathematical Finance | | |
| | state basics from accounting and costing and select | ed controlling methods. | | |
| Skills | Students are able to analyse business units with respect to out an Entrepreneurship project in a team. In particular, th | | ojectives, strategi | es etc.) and to ca |
| | | -, | | |
| | analyse Management goals and structure them appr | opriately | | |
| | analyse organisational and staff structures of compare | | | |
| | apply methods for decision making under multiple or | | nder risk | |
| | analyse production and procurement systems and B | usiness information systems | | |
| | analyse and apply basic methods of marketing | | | |
| | select and apply basic methods from mathematical to a select and apply basic methods from mathematical to a select the select and a sel | | | |
| | apply basic methods from accounting, costing and c | ontrolling to predefined problems | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to | | | |
| | work successfully in a team of students | | | |
| | to apply their knowledge from the lecture to an entr | anreneurship project and write a co | pherent report on | the project |
| | to communicate appropriately and | project and write a co | | the project |
| | to cooperate respectfully with their fellow students. | | | |
| | | | | |
| Autonomy | Students are able to | | | |
| | work in a team and to organize the team themselves | 5 | | |
| | - | | | |
| | 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 | | | | |
| Assignment for the | General Engineering Science (German program, 7 semeste | r): Core qualification: Compulsory | | |
| - | Civil- and Environmental Engineering: Specialisation Civil E | | | |
| | Civil- and Environmental Engineering: Specialisation Water | and Environment: Elective Compu | sory | |
| | Civil- and Environmental Engineering: Specialisation Traffic | and Mobility: Elective Compulsory | | |
| | | | | |
| | Bioprocess Engineering: Core qualification: Compulsory | | | |
| | Bioprocess Engineering: Core qualification: Compulsory Computer Science: Core qualification: Compulsory | | | |
| | Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory | | | |
| | Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory | | | |
| | Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: | | | |
| | Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: General Engineering Science (English program, 7 semester |): Specialisation Electrical Engineer | | |
| | Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester |): Specialisation Electrical Engineer): Specialisation Civil Engineering: | Compulsory | |
| | Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester |): Specialisation Electrical Engineer): Specialisation Civil Engineering:): Specialisation Bioprocess Engine | Compulsory ering: Compulsor | - |
| | Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester |): Specialisation Electrical Engineer): Specialisation Civil Engineering:): Specialisation Bioprocess Engine): Specialisation Energy and Enviro | Compulsory ering: Compulsor mental Engineeri | - |
| | Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester |): Specialisation Electrical Engineer): Specialisation Civil Engineering:): Specialisation Bioprocess Engine): Specialisation Energy and Enviro): Specialisation Computer Science | Compulsory ering: Compulsor mental Engineeri : Compulsory | ng: Compulsory |
| | Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester |): Specialisation Electrical Engineer): Specialisation Civil Engineering:): Specialisation Bioprocess Engine): Specialisation Energy and Enviro): Specialisation Computer Science | Compulsory ering: Compulsor mental Engineeri : Compulsory | ng: Compulsory |
| | Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester |): Specialisation Electrical Engineer): Specialisation Civil Engineering:): Specialisation Bioprocess Engine): Specialisation Energy and Enviro): Specialisation Computer Science lester): Specialisation Mechanical | Compulsory ering: Compulsor mental Engineeri : Compulsory Engineering, F | ng: Compulsory ocus Biomechani |
| | Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester |): Specialisation Electrical Engineer): Specialisation Civil Engineering:): Specialisation Bioprocess Engine): Specialisation Energy and Enviro): Specialisation Computer Science lester): Specialisation Mechanical | Compulsory ering: Compulsor mental Engineeri : Compulsory Engineering, F | ng: Compulsory ocus Biomechani |
| | Computer Science: Core qualification: Compulsory Data Science: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: General Engineering Science (English program, 7 semester General Engineering Science (English program, 7 semester Compulsory |): Specialisation Electrical Engineer): Specialisation Civil Engineering:): Specialisation Bioprocess Engine): Specialisation Energy and Enviro): Specialisation Computer Science ester): Specialisation Mechanical E ster): Specialisation Mechanical E | Compulsory ering: Compulsor mental Engineeri : Compulsory Engineering, Foct | ng: Compulsory ocus Biomechani ıs Energy Syster |

| 5 | |
|---|--|
| | 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 | ourse L0882: Management Tutorial | | | |
|------------|---|--|--|--|
| Тур | Recitation Section (small) | | | |
| Hrs/wk | κ 2 | | | |
| СР | 3 | | | |
| Workload | Independent Study Time 62, Study Time in Lecture 28 | | | |
| in Hours | | | | |
| Lecturer | r Prof. Christoph Ihl, Katharina Roedelius | | | |
| Language | e DE | | | |
| Cycle | vcle 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.

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

| | | Engineering" | | |
|--|---|----------------------|-------------------------|--|
| odule M0851: Mathematics II | | | | |
| urses | | | | |
| le | Тур | Hrs/wk | СР | |
| alysis II (L1025) | Lecture | 2 | 2 | |
| alysis II (L1026) | Recitation Section (large) | 1 | 1 | |
| alysis II (L1027) | Recitation Section (small) | 1 | 1 | |
| ear Algebra II (L0915) | Lecture | 2 | 2 | |
| ear Algebra II (L0916) | Recitation Section (small) | 1 | 1 | |
| ear Algebra II (L0917) | Recitation Section (large) | 1 | 1 | |
| | rectation beeckin (ange) | - | - | |
| Module Responsible Prof. Anusch Taraz | | | | |
| Admission Requirements None | | | | |
| Recommended Previous Mathematics I | | | | |
| Knowledge | | | | |
| Educational Objectives After taking part successfully, | tudents have reached the following learning results | | | |
| Professional Competence | | | | |
| • | | | | |
| Knowledge Students can name fu | her concepts in analysis and linear algebra. They are al | ble to explain th | em using appropriate | |
| examples. | | | | |
| | ical connections between these concepts. They are capabl | le of illustrating t | hese connections with | |
| | cur connections between these concepts. They are cupus | ie of mustrating t | nese connections with | |
| the help of examples. | and and any second on the sec | | | |
| Iney know proof strate | es and can reproduce them. | | | |
| | | | | |
| | | | | |
| Skills | | | | |
| Students can model press | plems in analysis and linear algebra with the help of the cor | ncepts studied in t | this course. Moreover, | |
| they are capable of solv | ng them by applying established methods. | | | |
| Students are able to dis | over and verify further logical connections between the cond | cepts studied in th | ie course. | |
| For a given problem, t | e students can develop and execute a suitable approach, | and are able to | critically evaluate the | |
| results. | | | | |
| | | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Students are able to work | k together in teams. They are capable to use mathematics a | s a common lang | uage. | |
| In doing so, they can ce | nmunicate new concepts according to the needs of their co | operating partner | s. Moreover, they can | |
| design examples to che | k and deepen the understanding of their peers. | | | |
| | | | | |
| | | | | |
| Autonomu | | | | |
| Autonomy Students are capable of | checking their understanding of complex concepts on their | · own. They can s | pecify open questions | |
| | e to get help in solving them. | 2 | | |
| | d sufficient persistence to be able to work for longer perio | ods in a goal-orie | nted manner on hard | |
| | a sumcient persistence to be able to work for longer perio | | | |
| problems. | | | | |
| | | | | |
| | | | | |
| Workload in Hours Independent Study Time 128, | tudy Time in Lecture 112 | | | |
| Credit points 8 | | | | |
| Course achievement None | | | | |
| | | | | |
| Examination Written exam | | | | |
| Examination duration and 60 min (Analysis II) + 60 min | near Algebra II) | | | |
| scale | | | | |
| Assignment for the General Engineering Science | erman program, 7 semester): Core qualification: Compulsor | У | | |
| Following Curricula Civil- and Environmental Engin | | | | |
| | Bioprocess Engineering: Core qualification: Compulsory | | | |
| | | | | |
| | Core qualification: Compulsory | | | |
| Electrical Engineering: Core qu | lification: Compulsory | | | |
| Energy and Environmental En | neering: Core qualification: Compulsory | | | |
| Green Technologies: Energy, | ater, Climate: Core qualification: Compulsory | | | |
| | ineering: Core qualification: Compulsory | | | |
| Logistics and Mobility: Core qu | | | | |
| | | | | |
| Mechanical Engineering: Core | | | | |
| Mechatronics: Core qualification | : Compulsory | | | |
| | cation: Elective Compulsory | | | |
| Orientation Studies: Core qual | | | | |
| Orientation Studies: Core qual Naval Architecture: Core quali | | | | |
| | cation: Compulsory | | | |
| Naval Architecture: Core quali Process Engineering: Core qua | cation: Compulsory |)ry | | |

| Course L1025: Analysis II | | |
|---------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | | |
| 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 | |

| ourse 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 | ozenten 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 | ecitation Section (small) | |
| Hrs/wk | 1 | |
| CP | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | ozenten des Fachbereiches Mathematik der UHH | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L0915: Linear Algebra | a li | |
|------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Anusch Taraz, Prof. Marko Lindner, Dr. Dennis Clemens | |
| 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 II | | |
|---------------------------------|--|--|
| Тур | ecitation 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, Dr. Dennis Clemens | |
| 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 | ourse L0917: Linear Algebra II | | |
|------------------------------|--|--|--|
| Тур | itation Section (large) | | |
| Hrs/wk | 1 | | |
| CP | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | rer Prof. Anusch Taraz, Prof. Marko Lindner, Dr. Christian Seifert, Dr. Dennis Clemens | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | |
|-------------------------------|--|---|--|--|
| Title | | Тур | Hrs/wk | СР |
| Programming Paradigms (L2169) | | Lecture | 2 | 2 |
| Programming Paradigms (L2170) | | Recitation Section (large) | 1 | 1 |
| Programming Paradigms (L2171) | | Practical Course | 2 | 3 |
| Module Responsible | NN | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Lecture on procedural programming or equiv | alent programming skills | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning results | | |
| Professional Competence | | | | |
| Personal Competence | fundamental understanding of polymorphis students know the concept of information exceptions and apply generic programming cons of both programming paradigms. Students can break down a medium-size programming language based on these s implementation generically and extensible | ubproblems. They can design a public an by abstraction. They can distinguish diffe ly in the implementation. They can design ar | e and compile-time blic and private me generic. The student heir own classes i d private interface erent language com | e polymorphism. T thods. They can u ts know the pros a n an object-orient and implement t structs of a mode |
| Autonomy | In a programming internship, students learn and independent solutions and receive feedt | | sion. In exercises th | ey develop individ |
| 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 | Computer Science: Core qualification: Comp | JIsory | | |
| - | Data Science: Core qualification: Compulsory | • | | |
| - | | | | |

| Course L2169: Programming | Paradigms | |
|---------------------------|---|--|
| Тур | ecture | |
| Hrs/wk | 2 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Dozenten des SD E | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | Cycle SoSe Content • fundamentals behind object orientated programming • classes and objects • inheritance (single, multiple) • interfaces • information hiding • exception handling • exception handling • generic programming and the implementation in the compiler • excursus in programming with dynamically typed programming languages | |
| Literature | Skript | |

| Course L2170: Programming | Paradigms | |
|---------------------------|---|--|
| Тур | citation Section (large) | |
| Hrs/wk | 1 | |
| CP | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dozenten des SD E | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | Cycle SoSe Content • fundamentals behind object orientated programming • classes and objects • inheritance (single, multiple) • interfaces • information hiding • exception handling • exception handling • generic programming and the implementation in the compiler • excursus in programming with dynamically typed programming languages | |
| Literature | Skript | |

| Course L2171: Programming | Paradigms | |
|---------------------------|--|--|
| Тур | Practical Course | |
| Hrs/wk | 2 | |
| CP | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Dozenten des SD E | |
| Language | DE/EN | |
| Cycle | joSe | |
| Content | Cycle SoSe Content • fundamentals behind object orientated programming • classes and objects • inheritance (single, multiple) • interfaces • information hiding • exception handling • generic programming and the implementation in the compiler • excursus in programming with dynamically typed programming languages | |
| Literature | Skript | |

| | rical Mathematics I |
|--|--|
| - | |
| Courses | |
| Title | Typ Hrs/wk CP |
| Numerical Mathematics I (L0417) Numerical Mathematics I (L0418) | Lecture 2 3 Recitation Section (small) 2 3 |
| Module Responsible | |
| Admission Requirements | |
| Recommended Previous | |
| Knowledge | Mathematik I + II for Engineering Students (german or english) or Analysis & Linear Algebra I + II for Technomathematici |
| Knowledge | basic MATLAB/Python knowledge |
| Educational Objectives | After taking part successfully, students have reached the following learning results |
| | After taking part successfully, students have reached the following learning results |
| Professional Competence | Students are able to |
| Kilowieuge | |
| | name numerical methods for interpolation, integration, least squares problems, eigenvalue problems, nonlinear root find |
| | 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 |
| | 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 knowled |
| | explain theoretical foundations and support each other with practical aspects regarding the implementation of algorithms |
| Autonopou | |
| 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 | |
| Course achievement | |
| Examination | |
| Examination duration and | |
| scale | 30 minutes |
| | General Engineering Science (German program, 7 semester): Specialisation Computer Science: Compulsory |
| Assignment for the | General Engineering Science (German program, 7 semescer). Specialisation computer Science, compulsory |
| - | General Engineering Science (German program 7 semester): Specialisation Mechanical Engineering Focus Materials |
| - | General Engineering Science (German program, 7 semester): Specialisation Mechanical Engineering, Focus Materials Engineering Sciences: Compulsory |
| - | Engineering Sciences: Compulsory |
| - | Engineering Sciences: Compulsory General Engineering Science (German program, 7 semester): Specialisation Biomedical Engineering: Compulsory |
| - | Engineering Sciences: Compulsory |
| - | 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 Biomechan |
| - | 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 Biomechan Compulsory |
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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 | |

| Module M0834: Comp | uternetworks and Internet S | Security | | |
|-----------------------------------|---|---|-----------------------|---------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | CP |
| Computer Networks and Internet Se | ecurity (11098) | Lecture | 3 | 5 |
| Computer Networks and Internet S | | Recitation Section (small) | 1 | 1 |
| Module Responsible | Prof. Andreas Timm-Giel | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basics of Computer Science | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students ha | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to explain important a | nd common Internet protocols in detail and class | ify them, in order t | to be able to analy |
| | and develop networked systems in furthe | er studies and job. | | |
| Skille | Students are able to analyze common int | ernet protocols and evaluate the use of them in d | ifforant domains | |
| SKIIIS | Students are able to analyse common inc | ernet protocols and evaluate the use of them in d | nereni domanis. | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | Students can select relevant parts out of | high amount of professional knowledge and can ir | ndependently 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 | | | | |
| - | | ogram, 7 semester): Specialisation Computer Scie | nce: Elective Comp | ulsory |
| Following Curricula | | | | |
| | Data Science: Core qualification: Elective | | | |
| | Electrical Engineering: Core qualification: | Elective Compulsory | | |
| | Engineering Science: Specialisation Mech | atronics: Elective Compulsory | | |
| | General Engineering Science (English pro | gram, 7 semester): Specialisation Computer Scier | ice: Elective Compu | llsory |
| | General Engineering Science (English pro | gram, 7 semester): Specialisation Mechatronics: E | lective 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 • Network management • Internet security: IPSec |
| Literature | 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 | |

| ourses | | | | |
|--|---|--|--|--|
| itle | | Тур | Hrs/wk | CP |
| omputer Engineering (L0321) omputer Engineering (L0324) | | Lecture Recitation Section (small) | 3 1 | 4 |
| Module Responsible | Prof Hoiko Falk | Accitation Section (Small) | | L |
| - | None | | | |
| | Basic knowledge in electrical engineering | | | |
| Knowledge | basic knowledge in electrical engineering | | | |
| 5 | After taking part successfully, students ha | ave reached the following learning results | | |
| Professional Competence | Arter taking part successivity, students he | the reaction the following learning results | | |
| Knowledge | programming down to gates. The module Introduction | n algebra, Boolean functions, hardware synthesis, | | |
| | Technological foundations Computer arithmetic: Integer addit Basics of computer architecture: Pr Memories: Memory hierarchies, SR. Input/output: I/O from the perspect | ion, subtraction, multiplication and division ogramming models, MIPS single-cycle architecture AM, DRAM, caches ive of the CPU, principles of passing data, point-to | -point connections | |
| Skills | composition of computer systems. The sti collection of few and simple components today's computing systems - from gates a After successful completion of the modu system and the software executed on it. on the hardware-centric abstraction layer | from the architect's perspective, i.e., they identify udents can analyze, how highly specific and indivi . They are able to distinguish between and to ex and circuits up to complete processors. le, the students are able to judge the interdeper In particular, they shall understand the consequent is from the assembly language down to gates. This els have on an entire system's performance and to | dual computers ca plain the different ndencies between nces that the exec is way, they will be | an be built based on abstraction layers a physical compu- cution of software h e enabled to evalue |
| Personal Competence Social Competence | Students are able to solve similar problem | ns alone or in a group and to present the results a | ccordingly. | |
| Autonomy | Students are able to acquire new knowled | lge from specific literature and to associate this kr | nowledge with oth | er classes. |
| Workload in Hours | Independent Study Time 124, Study Time | in Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | Compulsory Bonus Form Yes 10 % Excercises | Description | | |
| Examination | Written exam | | | |
| Examination duration and | 90 minutes, contents of course and labs | | | |
| scale | | | | |
| | General Engineering Science (German pro | ogram, 7 semester): Specialisation Computer Scier | nce: Compulsory | |
| Following Curricula | General Engineering Science (German pro General Engineering Science (German Compulsory General Engineering Science (German pro Engineering: Compulsory General Engineering Science (German pro Engineering: Compulsory | ogram, 7 semester): Specialisation Civil Engineerin ogram, 7 semester): Specialisation Process Engine program, 7 semester): Specialisation Mechanic orogram, 7 semester): Specialisation Mechanica ogram, 7 semester): Specialisation Mechanical Engineering program, 7 semester): Specialisation Mechanical Engineering program Program Progra | ering: Compulsory ical Engineering, Il Engineering, Fo gineering, Focus T | Focus Mechatroni cus Aircraft Syster heoretical Mechani |
| | Engineering Sciences: Compulsory General Engineering Science (German pr and Production: Compulsory General Engineering Science (German p Compulsory | ogram, 7 semester): Specialisation Mechanical Er program, 7 semester): Specialisation Mechanica | ngineering, Focus I Engineering, Foc | Product Developme cus Energy Systen |
| | Compulsory General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German pro General Engineering Science (German pro Computer Science: Core qualification: Cor Data Science: Core qualification: Elective Electrical Engineering: Core qualification: | Compulsory | ure: Compulsory ineering: Compuls viromental Enginee ineering: Compuls eering: Compulso | ory ering: Compulsory ory |

| 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. | |

| 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 |

| Markela Moore | | | | |
|--|--|---|------------------------------------|----------------------------|
| Module M0853: Math | ematics III | | | |
| Courses | | | | |
| | | | | |
| Title | | Тур | Hrs/wk | CP |
| Analysis III (L1028) | | Lecture | 2 | 2 |
| Analysis III (L1029) | | Recitation Section (small) | 1 | 1 |
| Analysis III (L1030) | | Recitation Section (large) | 1 | 1 |
| Differential Equations 1 (Ordinary | Differential Equations) (L1031) | Lecture | 2 | 2 |
| Differential Equations 1 (Ordinary | Differential Equations) (L1032) | Recitation Section (small) | 1 | 1 |
| Differential Equations 1 (Ordinary | 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 | the following learning results | | |
| Professional Competence | | | | |
| Knowledge | | | | |
| , nonedge | Students can name the basic concepts in the area | rea of analysis and differential equations | . They are able t | o explain them usin |
| | appropriate examples. | | | |
| | Students can discuss logical connections between | een these concepts. They are capable | of illustrating th | ese connections wit |
| | the help of examples. | | or mascracing cri | |
| | | the sure | | |
| | They know proof strategies and can reproduce | uleni. | | |
| | | | | |
| | | | | |
| Skills | | | | and the stand of the state |
| | Students can model problems in the area of an | - | e help of the cor | icepts studied in thi |
| | course. Moreover, they are capable of solving t | hem by applying established methods. | | |
| | Students are able to discover and verify further | logical connections between the concep | ots studied in the | e course. |
| | For a given problem, the students can develop | op and execute a suitable approach, and | nd are able to c | ritically evaluate th |
| | results. | | | |
| | | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Chudanta and able to work to add on in terms. T | | | |
| | Students are able to work together in teams. The second seco | | | |
| | In doing so, they can communicate new concept | | erating partners | . Moreover, they ca |
| | design examples to check and deepen the unde | erstanding of their peers. | | |
| | | | | |
| | | | | |
| Autonomy | | | | |
| Autonomy | Students are capable of checking their underst | tanding of complex concepts on their or | wn. They can sp | ecify open question |
| | precisely and know where to get help in solving | them. | | |
| | Students have developed sufficient persistence | | s in a goal-orien | ted manner on har |
| | | ie to be able to nonk for longer period. | s in a goar orien | |
| | problems. | | | |
| | | | | |
| | | | | |
| | Independent Study Time 128, Study Time in Lecture 1 | 112 | | |
| Para dia second | 8 | | | |
| Credit points | + | | | |
| Course achievement | | | | |
| · · | | | | |
| Course achievement | Written exam | 1) | | |
| Course achievement Examination | Written exam 60 min (Analysis III) + 60 min (Differential Equations 1 | 1) | | |
| Course achievement Examination Examination duration and | Written exam 60 min (Analysis III) + 60 min (Differential Equations 2 | | | |
| Course achievement Examination Examination duration and scale | Written exam 60 min (Analysis III) + 60 min (Differential Equations 3 General Engineering Science (German program, 7 sen | nester): Core qualification: Compulsory | | |
| Course achievement Examination Examination duration and scale Assignment for the | Written exam 60 min (Analysis III) + 60 min (Differential Equations 3 General Engineering Science (German program, 7 sen | nester): Core qualification: Compulsory on: Compulsory | | |
| Course achievement Examination Examination duration and scale Assignment for the | Written exam 60 min (Analysis III) + 60 min (Differential Equations 2 General Engineering Science (German program, 7 sen Civil- and Environmental Engineering: Core qualification | nester): Core qualification: Compulsory on: Compulsory ry | | |
| Course achievement Examination Examination duration and scale Assignment for the | Written exam 60 min (Analysis III) + 60 min (Differential Equations 2 General Engineering Science (German program, 7 sen Civil- and Environmental Engineering: Core qualificatio Bioprocess Engineering: Core qualification: Compulso Digital Mechanical Engineering: Core qualification: Co | nester): Core qualification: Compulsory on: Compulsory ry mpulsory | | |
| Course achievement Examination Examination duration and scale Assignment for the | Written exam 60 min (Analysis III) + 60 min (Differential Equations 2 General Engineering Science (German program, 7 sen Civil- and Environmental Engineering: Core qualificatio Bioprocess Engineering: Core qualification: Compulson Digital Mechanical Engineering: Core qualification: Co Electrical Engineering: Core qualification: Compulsory | nester): Core qualification: Compulsory on: Compulsory ry mpulsory | | |
| Course achievement Examination Examination duration and scale Assignment for the | Written exam 60 min (Analysis III) + 60 min (Differential Equations 2 General Engineering Science (German program, 7 sen Civil- and Environmental Engineering: Core qualificatio Bioprocess Engineering: Core qualification: Compulson Digital Mechanical Engineering: Core qualification: Co Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualificat | nester): Core qualification: Compulsory on: Compulsory ry mpulsory ation: Compulsory | | |
| Course achievement Examination Examination duration and scale Assignment for the | Written exam 60 min (Analysis III) + 60 min (Differential Equations 2 General Engineering Science (German program, 7 sen Civil- and Environmental Engineering: Core qualificatio Bioprocess Engineering: Core qualification: Compulsor Digital Mechanical Engineering: Core qualification: Co Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualificat Green Technologies: Energy, Water, Climate: Core qualificat | nester): Core qualification: Compulsory on: Compulsory ry mpulsory ation: Compulsory alification: Compulsory | | |
| Course achievement Examination Examination duration and scale Assignment for the | Written exam 60 min (Analysis III) + 60 min (Differential Equations 2 General Engineering Science (German program, 7 sen Civil- and Environmental Engineering: Core qualificatio Bioprocess Engineering: Core qualification: Compulsor Digital Mechanical Engineering: Core qualification: Co Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualificat Green Technologies: Energy, Water, Climate: Core qua Computational Science and Engineering: Core qualific | nester): Core qualification: Compulsory on: Compulsory ry mpulsory ation: Compulsory alification: Compulsory ation: Compulsory | | |
| Course achievement Examination Examination duration and scale Assignment for the | Written exam 60 min (Analysis III) + 60 min (Differential Equations 2 General Engineering Science (German program, 7 sen Civil- and Environmental Engineering: Core qualificatio Bioprocess Engineering: Core qualification: Compulsor Digital Mechanical Engineering: Core qualification: Co Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification Green Technologies: Energy, Water, Climate: Core qualification | nester): Core qualification: Compulsory on: Compulsory ry mpulsory ation: Compulsory alification: Compulsory ation: Compulsory | | |
| Course achievement Examination Examination duration and scale Assignment for the | Written exam 60 min (Analysis III) + 60 min (Differential Equations 2 General Engineering Science (German program, 7 sen Civil- and Environmental Engineering: Core qualificatio Bioprocess Engineering: Core qualification: Compulsor Digital Mechanical Engineering: Core qualification: Co Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualificat Green Technologies: Energy, Water, Climate: Core qua Computational Science and Engineering: Core qualific | nester): Core qualification: Compulsory on: Compulsory ry mpulsory ation: Compulsory alification: Compulsory ation: Compulsory ation: Compulsory and Systems: Elective Compulsory | Sory | |
| Course achievement Examination Examination duration and scale Assignment for the | Written exam 60 min (Analysis III) + 60 min (Differential Equations 2 General Engineering Science (German program, 7 sen Civil- and Environmental Engineering: Core qualification Bioprocess Engineering: Core qualification: Compulson Digital Mechanical Engineering: Core qualification: Co Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualificat Green Technologies: Energy, Water, Climate: Core qua Computational Science and Engineering: Core qualific Logistics and Mobility: Specialisation Traffic Planning a | nester): Core qualification: Compulsory on: Compulsory ry mpulsory ation: Compulsory alification: Compulsory ation: Compulsory ation: Compulsory and Systems: Elective Compulsory gement and Processes: Elective Compul | sory | |
| Course achievement Examination Examination duration and scale Assignment for the | Written exam 60 min (Analysis III) + 60 min (Differential Equations 2 General Engineering Science (German program, 7 sen Civil- and Environmental Engineering: Core qualification Bioprocess Engineering: Core qualification: Compulson Digital Mechanical Engineering: Core qualification: Co Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualificat Green Technologies: Energy, Water, Climate: Core qualificat Computational Science and Engineering: Core qualific Logistics and Mobility: Specialisation Traffic Planning a Logistics and Mobility: Specialisation Information Tech | nester): Core qualification: Compulsory on: Compulsory ry mpulsory ation: Compulsory alification: Compulsory ation: Compulsory ation: Compulsory and Systems: Elective Compulsory igement and Processes: Elective Compul inology: Compulsory | sory | |
| Course achievement Examination Examination duration and scale Assignment for the | Written exam 60 min (Analysis III) + 60 min (Differential Equations 2 General Engineering Science (German program, 7 sen Civil- and Environmental Engineering: Core qualification Bioprocess Engineering: Core qualification: Compulson Digital Mechanical Engineering: Core qualification: Co Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualificat Green Technologies: Energy, Water, Climate: Core qualificat Computational Science and Engineering: Core qualific Logistics and Mobility: Specialisation Traffic Planning a Logistics and Mobility: Specialisation Information Tech Mechanical Engineering: Core qualification: Compulso | nester): Core qualification: Compulsory on: Compulsory ry mpulsory ation: Compulsory alification: Compulsory ation: Compulsory ation: Compulsory and Systems: Elective Compulsory igement and Processes: Elective Compul inology: Compulsory | sory | |
| Course achievement Examination Examination duration and scale Assignment for the | Written exam 60 min (Analysis III) + 60 min (Differential Equations 2 General Engineering Science (German program, 7 sen Civil- and Environmental Engineering: Core qualificatio Bioprocess Engineering: Core qualification: Compulson Digital Mechanical Engineering: Core qualification: Co Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualificat Green Technologies: Energy, Water, Climate: Core qualifica Green Technologies: Energy, Water, Climate: Core qualifications Logistics and Mobility: Specialisation Traffic Planning a Logistics and Mobility: Specialisation Production Mana Logistics and Mobility: Specialisation Information Tech Mechanical Engineering: Core qualification: Compulson Mechatronics: Core qualification: Compulsory | nester): Core qualification: Compulsory on: Compulsory ry mpulsory ation: Compulsory alification: Compulsory ation: Compulsory ation: Compulsory and Systems: Elective Compulsory igement and Processes: Elective Compul inology: Compulsory | sory | |
| Course achievement Examination Examination duration and scale Assignment for the | Written exam 60 min (Analysis III) + 60 min (Differential Equations 2 General Engineering Science (German program, 7 sen Civil- and Environmental Engineering: Core qualification Bioprocess Engineering: Core qualification: Compulson Digital Mechanical Engineering: Core qualification: Co Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification Green Technologies: Energy, Water, Climate: Core qualification Computational Science and Engineering: Core qualific Logistics and Mobility: Specialisation Traffic Planning a Logistics and Mobility: Specialisation Information Tech Mechanical Engineering: Core qualification: Compulson Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory | nester): Core qualification: Compulsory on: Compulsory ry mpulsory ation: Compulsory alification: Compulsory ation: Compulsory ation: Compulsory and Systems: Elective Compulsory igement and Processes: Elective Compul inology: Compulsory | sory | |
| Course achievement Examination Examination duration and scale Assignment for the | Written exam 60 min (Analysis III) + 60 min (Differential Equations 2 General Engineering Science (German program, 7 sen Civil- and Environmental Engineering: Core qualificatio Bioprocess Engineering: Core qualification: Compulson Digital Mechanical Engineering: Core qualification: Co Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualificat Green Technologies: Energy, Water, Climate: Core qualifica Green Technologies: Energy, Water, Climate: Core qualifications Logistics and Mobility: Specialisation Traffic Planning a Logistics and Mobility: Specialisation Production Mana Logistics and Mobility: Specialisation Information Tech Mechanical Engineering: Core qualification: Compulson Mechatronics: Core qualification: Compulsory | nester): Core qualification: Compulsory on: Compulsory ry mpulsory ation: Compulsory alification: Compulsory ation: Compulsory ation: Compulsory and Systems: Elective Compulsory igement and Processes: Elective Compul inology: Compulsory | sory | |
| Course achievement Examination Examination duration and scale Assignment for the | Written exam 60 min (Analysis III) + 60 min (Differential Equations 2 General Engineering Science (German program, 7 sen Civil- and Environmental Engineering: Core qualification Bioprocess Engineering: Core qualification: Compulson Digital Mechanical Engineering: Core qualification: Co Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification Green Technologies: Energy, Water, Climate: Core qualification Computational Science and Engineering: Core qualific Logistics and Mobility: Specialisation Traffic Planning a Logistics and Mobility: Specialisation Information Tech Mechanical Engineering: Core qualification: Compulson Mechatronics: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory | nester): Core qualification: Compulsory on: Compulsory ry mpulsory ation: Compulsory alification: Compulsory ation: Compulsory and Systems: Elective Compulsory igement and Processes: Elective Compul- inology: Compulsory ry | | ective Compulsory |
| Course achievement Examination Examination duration and scale Assignment for the | Written exam 60 min (Analysis III) + 60 min (Differential Equations 2 General Engineering Science (German program, 7 sen Civil- and Environmental Engineering: Core qualificatio Bioprocess Engineering: Core qualification: Compulson Digital Mechanical Engineering: Core qualification: Co Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualificat Green Technologies: Energy, Water, Climate: Core qua Computational Science and Engineering: Core qualific Logistics and Mobility: Specialisation Traffic Planning a Logistics and Mobility: Specialisation Information Tech Mechanical Engineering: Core qualification: Compulson Mechatroncis: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory | nester): Core qualification: Compulsory on: Compulsory ry mpulsory ation: Compulsory alification: Compulsory ation: Compulsory and Systems: Elective Compulsory rgement and Processes: Elective Compul nology: Compulsory ry Mobility: Specialisation Traffic Planning | and Systems: Ele | |
| Course achievement Examination Examination duration and scale Assignment for the | Written exam 60 min (Analysis III) + 60 min (Differential Equations 1 General Engineering Science (German program, 7 sen Civil- and Environmental Engineering: Core qualificatio Bioprocess Engineering: Core qualification: Compulsory Digital Mechanical Engineering: Core qualification: Co Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualific Green Technologies: Energy, Water, Climate: Core qualific Computational Science and Engineering: Core qualific Logistics and Mobility: Specialisation Traffic Planning a Logistics and Mobility: Specialisation Information Tech Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory Engineering and Management - Major in Logistics and | nester): Core qualification: Compulsory on: Compulsory ry mpulsory ation: Compulsory alification: Compulsory ation: Compulsory and Systems: Elective Compulsory rgement and Processes: Elective Compul nology: Compulsory ry Mobility: Specialisation Traffic Planning | and Systems: Ele | |
| Course achievement Examination Examination duration and scale Assignment for the | Written exam 60 min (Analysis III) + 60 min (Differential Equations : General Engineering Science (German program, 7 sen Civil- and Environmental Engineering: Core qualificatio Bioprocess Engineering: Core qualification: Compulsory Digital Mechanical Engineering: Core qualification: Co Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualific Green Technologies: Energy, Water, Climate: Core qui Computational Science and Engineering: Core qualific Logistics and Mobility: Specialisation Traffic Planning a Logistics and Mobility: Specialisation Information Tech Mechanical Engineering: Core qualification: Compulsory Naval Architecture: Core qualification: Compulsory Process Engineering: Core qualification: Compulsory Engineering and Management - Major in Logistics and Engineering and Panagement - Major in Lo | nester): Core qualification: Compulsory on: Compulsory ry mpulsory ation: Compulsory alification: Compulsory ation: Compulsory and Systems: Elective Compulsory rgement and Processes: Elective Compul nology: Compulsory ry Mobility: Specialisation Traffic Planning nd Mobility: Specialisation Production M | and Systems: Ele lanagement and | Processes: Elective |

| 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 |
| Literature | |
| | http://www.math.uni-hamburg.de/teaching/export/tuhh/index.html |

| Course L1029: Analysis III | | |
|----------------------------|---|--|
| 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 | |

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

| Course L1032: Differential Equations 1 (Ordinary Differential Equations) | | |
|--|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| 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 L1033: Differential Ec | 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 | See interlocking course |
| Literature | See interlocking course |

| Courses | | | | |
|--|--|---|---------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Algorithms and Data Structures (L2 | 046) | Lecture | 4 | 4 |
| Algorithms and Data Structures (L2 | 047) | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Matthias Mnich | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | Discrete Algebraic Structures Mathematics I | | | |
| | Mathematics I Mathematics II | | | |
| | Procedual Programming | | | |
| | Objectoriented Programming | | | |
| | | | | |
| Educational Objectives | After taking part successfully, students have reache | d the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students can name the basic concepts in al | agrithm design algorithm analysis and | problem reduction | ns. Thoy are able |
| | explain them using appropriate examples. | | problem reduction | iis. They are able |
| | Students can discuss logical connections bet | ween these concepts. They are capable | of illustrating the | ese connections w |
| | the help of examples. | | or muscrating and | |
| | They know proof strategies and can reproduce | e them. | | |
| | | | | |
| Skills | Students can model discrete decision, search | and optimization problems with the help | of the concepts s | tudied in this cou |
| | Moreover, they are capable of solving them, | | | |
| | Students are able to discover and verify furth | | | |
| | • For a given problem, the students can deve | elop and execute a suitable approach, a | nd are able to ci | ritically evaluate |
| | results. | | | |
| Devenuel Commetence | | | | |
| Personal Competence Social Competence | | | | |
| Social Competence | Students are able to work together in teams. | They are capable to use mathematics as | a common langua | age. |
| | In doing so, they can communicate new cond | cepts according to the needs of their coop | perating partners | . Moreover, they o |
| | design examples to check and deepen the un | derstanding of their peers. | | |
| Autonomy | | | | |
| Autonomy | Students are capable of checking their under | rstanding of complex concepts on their c | own. They can sp | ecify open questio |
| | precisely and know where to get help in solvi | ng them. | | |
| | Students have developed sufficient persister | nce to be able to work for longer period | ls in a goal-orien | ted manner on ha |
| | problems. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture | 2 70 | | |
| Credit points | | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 60 min | | | |
| scale | | | | |
| Assignment for the | Computer Science: Core qualification: Compulsory | | | |
| Following Curricula | Data Science: Core qualification: Compulsory | | | |
| | Computational Science and Engineering: Core qualif | ication: Compulsory | | |
| | Logistics and Mobility: Specialisation Information Te | chnology: Elective Compulsory | | |
| | Technomathematics: Specialisation II. Informatics: E | ective Compulsory | | |
| | Engineering and Management - Major in Logistics ar | nd Mobility: Specialisation Information Tec | hnoloav: Elective | Compulsory |

| Course L2046: Algorithms and Data Structures | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 4 | |
| CP | 4 | |
| Workload in Hours | Independent Study Time 64, Study Time in Lecture 56 | |
| Lecturer | Prof. Matthias Mnich | |
| Language | DE/EN | |
| Cycle | WiSe | |
| Content | Insertion sort Register machines Asymptotic analysis, Landau notation Polynomial-time algorithms and NP-completeness Divide-and-conquer, merge sort Strassen algorithm Greedy algorithm Dynamic programming Quick sort AVL-trees, B-trees Hashing Depth first search, breadth first search Shortest paths Flow problems, Ford-Fulkerson algorithm | |
| Literature | T. Cormen, Ch. Leiserson, R. Rivest, C. Stein: Introduction to Algorithms. MIT Press, 2013 S. Skiena: The Algorithm Design Manual. Springer, 2008 J. M. Kleinberg and É. Tardos. Algorithm Design. Addison-Wesley, 2005. | |

| Course L2047: Algorithms and Data Structures | | |
|--|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Matthias Mnich | |
| Language | DE/EN | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Engineering | | | | |
|-----------------------------|--|--|--------------------|------------------------|
| Module M0672: Signa | ls and Systems | | | |
| | | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Signals and Systems (L0432) | | Lecture | 3 | 4 |
| Signals and Systems (L0433) | | Recitation Section (small) | 2 | 2 |
| Module Responsible | Prof. Gerhard Bauch | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mathematics 1-3 | | | |
| Knowledge | The modul is an introduction to the theory of signals | and systems. Good knowledge in maths | as covored by the | n module Mathemati |
| | 1-3 is expected. Further experience with spectral tra | | - | |
| | but not required. | instormations (Fourier Series, Fourier tra | insionin, Euplace | transformy is usefu |
| | | | | |
| Educational Objectives | After taking part successfully, students have reached | the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are able to classify and describe signal | s and linear time-invariant (LTI) systems | using methods of | of signal and system |
| | theory. They are able to apply the fundamental tran | sformations of continuous-time and disc | rete-time signals | and systems. They |
| | can describe and analyse deterministic signals and | systems mathematically in both time ar | nd image domaii | n. In particular, they |
| | understand the effects in time domain and image | domain which are caused by the transit | ion of a continu | ous-time signal to a |
| | discrete-time signal. | | | |
| Skills | The students are able to describe and analyse determ | ninistic signals and linear time-invariant | systems using m | ethods of signal and |
| | system theory. They can analyse and design basis | c systems regarding important proper | ties such as ma | ignitude and phase |
| | response, stability, linearity etc They can assess the | impact of LTI systems on the signal prop | perties in time ar | nd frequency domain |
| Personal Competence | | | | |
| Social Competence | The students can jointly solve specific problems. | | | |
| Autonomy | The students are able to acquire relevant inform | ation from appropriate literature sourc | es. They can c | ontrol their level o |
| | knowledge during the lecture period by solving tutori | al problems, software tools, clicker syste | m. | |
| 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 se | mester): Core qualification: Compulsory | | |
| Following Curricula | Computer Science: Core qualification: Compulsory | | | |
| | Computer Science: Specialisation II. Mathematics and | l Engineering Science: Elective Compulso | ry | |
| | Data Science: Core qualification: Compulsory | | | |
| | Electrical Engineering: Core qualification: Compulsory | | | |
| | Computational Science and Engineering: Core qualified | | | |
| | Mechanical Engineering: Specialisation Mechatronics | Elective Compulsory | | |
| | Mechatronics: Core qualification: Compulsory | | | |
| | Technomathematics: Specialisation III. Engineering S | cience: Elective Compulsory | | |

| Typ 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 Cortent • Introduction to signal and system theory • Signals • Cassification of signals • Continuous-time and discrete-time signals • Continuous-time and discrete-time signals • Analog and digital signals • Description of LTI systems by differential equations or difference equations, respectively • Basic properties of signals • Description of LTI systems by differential equations or signals • Elementary signals • Distributions (Generalized Functions) • Power and energy of signals • Correlation functions • Correlation functions of deterministic signals • Autocorrelation function • Orthogonal signals • Correlation function • Orthogonal signals • Autocorrelation function • Orthogonal signals • Autocorrelation function • Autocorrelation function • Orthogonal signals • Linear time-invariant (LTI) systems • Linear time-invariant (LTI) systems | Course L0432: Signals and S | ystems |
|--|-----------------------------|--|
| CP 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 • Description of LT systems by differential equations or difference equations, respectively • Basic properties of signals and operations on signals • Elementary signals • Description of LT systems by differential equations or difference equations, respectively • Basic properties of signals and operations on signals • Distributions (Generalized Functions) • Power and energy of signals • Correlation functions of deterministic signals • Autocorrelation function • Crosscorrelation function • Othogonal signals • Applications of correlation • Linear time-invariant (LTI) systems | Тур | Lecture |
| Workload in Hours Independent Study Time 78, Study Time in Lecture 42 Lecturer Prof. Gerhard Bauch Language DE/EN Content • Introduction to signal and system theory • Signals • Continuous-time and discrete-time signals • Continuous-time and discrete-time signals • Deterministic and random signals • Deterministic and random signals • Deterministic and random signals • Description of LTI systems by differential equations or difference equations, respectively • Basic properties of signals and operations on signals • Distributions (Generalized Functions) • Power and energy of signals • Correlation function • Autocorrelation function • Autocorrelation function • Autocorrelation function • Orthogonal signals | Hrs/wk | 3 |
| Lecture 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 Distributions (Generalized Functions) Power and energy of signals Correlation function Autocorrelation function Orthogonal signals Autocorrelation function Orthogonal signals Applications of correlation Linear time-invariant (LTI) systems | CP | 4 |
| Language DE/EN 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 Destributions (Generalized Functions) Power and energy of signals Correlation function Crosscorrelation function Orthogonal signals Autocorrelation function Orthogonal signals Applications of correlation Utime-invariant (LTI) systems Linear time-invariant (LTI) systems | Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Content Introduction to signal and system theory Signals Classification of signals Continuous-time and discrete-time signals Analog and digital signals | Lecturer | Prof. Gerhard Bauch |
| Content • Introduction to signal and system theory • Signals • Classification of signals • Continuous-time and discrete-time 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 function function • Autocorrelation function • Orthogonal signals • Orthogonal signals • Linear time-invariant (LTI) systems | Language | DE/EN |
| Introduction to signal and system theory Signals Classification of signals Continuous-time and discrete-time signals Analog and digital signals Deterministic and random 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 function Orthogonal signals Applications of correlation | Cycle | SoSe |
| 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 function Crosscorrelation function Orthogonal signals Applications of correlation Linear time-invariant (LTI) systems | Content | |
| 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 function Crosscorrelation function Orthogonal signals Applications of correlation Linear time-invariant (LTI) systems | | • 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 function Crosscorrelation function Orthogonal signals Applications of correlation Linear time-invariant (LTI) systems | | Classification of 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 function Crosscorrelation function Orthogonal signals Applications of correlation Linear time-invariant (LTI) systems | | Continuous-time and discrete-time 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 function Crosscorrelation function Orthogonal signals Applications of correlation Linear time-invariant (LTI) systems | | |
| Basic properties of signals and operations on signals Elementary signals Distributions (Generalized Functions) Power and energy of signals Correlation functions of deterministic signals Autocorrelation function Crosscorrelation function Orthogonal signals Applications of correlation Linear time-invariant (LTI) systems | | |
| Elementary signals Distributions (Generalized Functions) Power and energy of signals Correlation functions of deterministic signals Autocorrelation function Crosscorrelation function Orthogonal signals Applications of correlation Linear time-invariant (LTI) systems | | Description of LTI systems by differential equations or difference equations, respectively |
| Distributions (Generalized Functions) Power and energy of signals Correlation functions of deterministic signals Autocorrelation function Crosscorrelation function Orthogonal signals Applications of correlation Linear time-invariant (LTI) systems | | Basic properties of signals and operations on signals |
| Power and energy of signals Correlation functions of deterministic signals Autocorrelation function Crosscorrelation function Orthogonal signals Applications of correlation Linear time-invariant (LTI) systems | | |
| Correlation functions of deterministic signals Autocorrelation function Crosscorrelation function Orthogonal signals Applications of correlation Linear time-invariant (LTI) systems | | |
| Autocorrelation function Crosscorrelation function Orthogonal signals Applications of correlation Linear time-invariant (LTI) systems | | |
| Crosscorrelation function Orthogonal signals Applications of correlation Linear time-invariant (LTI) systems | | - |
| Orthogonal signals Applications of correlation Linear time-invariant (LTI) systems | | |
| Applications of correlation Linear time-invariant (LTI) systems | | |
| Linear time-invariant (LTI) systems | | |
| | | |
| | | |
| | | • Linearity |
| • Time-invariance | | Time-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

Literature

- Allpass filters
- Minimum-phase, maximum-phase and mixed-phase filters
- Linear phase filters
- 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.

L

| Course L0433: Signals and Systems | |
|-----------------------------------|---|
| | Recitation Section (small) |
| Hrs/wk | 2 |
| CP | 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 |

| Engineering | | | | |
|-----------------------------|--|---|-------------------|------------------------|
| Module M0803: Embe | dded Systems | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Embedded Systems (L0805) | | Lecture | 3 | 4 |
| Embedded Systems (L0806) | | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Heiko Falk | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Computer Engineering | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached th | e following learning results | | |
| Professional Competence | | | | |
| Knowledge | Embedded systems can be defined as information proc | essing systems embedded into enclos | ing products. Thi | s course teaches the |
| | foundations of such systems. In particular, it deals with | an introduction into these systems (| notions, commor | characteristics) and |
| | their specification languages (models of computation, | hierarchical automata, specification | of distributed sy | vstems, task graphs, |
| | specification of real-time applications, translations betw | veen different models). | | |
| | Another part covers the hardware of embedded syste | ems: Sonsors, A/D and D/A converter | rs. real-time can | able communication |
| | hardware, embedded processors, memories, energy di | | | |
| | introduction into real-time operating systems, middle | | | |
| | systems using hardware/software co-design (hardware | | | |
| | efficient realizations, compilers for embedded processo | | | |
| | | | | |
| Skills | After having attended the course, students shall be al | | | |
| | relevant parts of technological competences to use in o | | | |
| | able to compare different models of computations and | | iesign. They sha | Il be able to judge ir |
| Devenuel Commetence | which areas of embedded system design specific risks e | exist. | | |
| Personal Competence | Students are able to calve similar problems alone or in | aroup and to procept the results acc | ordinaly | |
| Social Competence | Students are able to solve similar problems alone or in a | a group and to present the results acco | brunigiy. | |
| Autonomy | Students are able to acquire new knowledge from speci | fic literature and to associate this know | wledge with othe | r classes. |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | | | | |
| Course achievement | | ription | | |
| | Yes 10 % Subject theoretical and | | | |
| | practical work | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 minutes, contents of course and labs | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 seme | ster): Specialisation Computer Science | e: Compulsory | |
| Following Curricula | Computer Science: Specialisation Computer and Softwa | re Engineering: Elective Compulsory | | |
| | Computer Science: Specialisation I. Computer and Softv | | | |
| | Electrical Engineering: Core qualification: Elective Comp | , | | |
| | Engineering Science: Specialisation Mechatronics: Elect | | | |
| | Aircraft Systems Engineering: Core qualification: Electiv | | | |
| | General Engineering Science (English program, 7 semes | | tive Compulsory | |
| | Computational Science and Engineering: Core qualificat | | | |
| | Mechatronics: Specialisation System Design: Elective Co | | | |
| | Mechatronics: Specialisation Intelligent Systems and Ro | botics: Elective Compulsory | | |
| | Mechatronics: Core qualification: Elective Compulsory | | | |
| | Microelectronics and Microsystems: Specialisation Embe | edded Systems: Elective Compulsory | | |

| Course L0805: Embedded Sy | stems |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Heiko Falk |
| Language | EN |
| Cycle | SoSe |
| Content | Introduction Specifications and Modeling Embedded/Cyber-Physical Systems Hardware System Software Evaluation and Validation Mapping of Applications to Execution Platforms Optimization Peter Marwedel. Embedded System Design - Embedded Systems Foundations of Cyber-Physical Systems. 2 nd Edition, |
| | Peter Marwedel. Embedded System Design - Embedded Systems Foundations of Cyber-Physical Systems. 2nd Edition, Springer, 2012., Springer, 2012. |

| Course L0806: Embedded Systems | |
|--------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| CP | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Heiko Falk |
| Language | EN |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Courses | | | | |
|---------------------------------|--|--|--------------------------|-------|
| Title | | Тур | Hrs/wk | СР |
| ntroductory Seminar Computer Sc | ience I (L2362) | Seminar | 2 | 3 |
| ntroductory Seminar Computer Sc | ience II (L2361) | Seminar | 2 | 3 |
| Module Responsible | Prof. Karl-Heinz Zimmermann | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge of Computer Science ar | nd Mathematics at the Bachelor's level. | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students h | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are able to | | | |
| | explicate a specific topic in the fie | ld of Computer Science | | |
| | explicate a specific topic in the ne describe complex issues, | la di computer science, | | |
| | present different views and evaluation | ate in a critical way | | |
| | · present uncrent views and evalue | ace in a critical way. | | |
| Skills | The students are able to | | | |
| | familiarize in a specific topic of Co | mouter Science in limited time | | |
| | | specific topic and cite in a correct way, | | |
| | elaborate a presentation and give | | | |
| | sum up the presentation in 10-15 | | | |
| | answer questions in the final discu | ission. | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | The students are able to | | | |
| | elaborate and introduce a topic for | r a certain audience, | | |
| | discuss the topic, content and structure | cture of the presentation with the instructor, | | |
| | discuss certain aspects with the ar | udience, and | | |
| | as the lecturer listen and respond | to questions from the audience. | | |
| Autonomy | The students are able to | | | |
| Autonomy | | | | |
| | define the task in question in an a | utonomous way, | | |
| | develop the necessary knowledge | , | | |
| | use appropriate work equipment, | and | | |
| | guided by an instructor critically c | heck the working status. | | |
| Workload in Hours | Independent Study Time 124, Study Time | e in Lecture 56 | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | | | | |
| Examination duration and | | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German pr | ogram, 7 semester): Specialisation Computer S | cience: Elective Compute | sorv |
| Following Curricula | | | cience. Liective computs | 301 Y |
| i onowing curricula | | ogram, 7 semester): Specialisation Computer So | cience: Flective Compuls | orv |
| | Computational Science and Engineering: | | elective compuls | , |

| Course L2362: Introductory | Seminar Computer Science I |
|----------------------------|---|
| Тур | Seminar |
| 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/SoSe |
| Content | |
| Literature | |

| Course L2361: Introductory | Course L2361: Introductory Seminar Computer Science II | |
|----------------------------|--|--|
| Тур | Seminar | |
| 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/SoSe | |
| Content | | |
| Literature | | |

| Engineering | | | | |
|--------------------------------------|--|--|--------------------|----------------------|
| Module M0727: Stoch | astics | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Stochastics (L0777) | | Lecture | 2 | 4 |
| Stochastics (L0778) | | Recitation Section (small) | 2 | 2 |
| Module Responsible | Prof. Matthias Schulte | | | |
| Admission Requirements | | | | |
| Recommended Previous | Calculus | | | |
| Knowledge | Discrete algebraic structures (combinatorics) | | | |
| | Propositional logic | | | |
| Educational Objectives | After telving pertension of the students have reached | the following location results | | |
| | After taking part successfully, students have reached t | the following learning results | | |
| Professional Competence Knowledge | | | | |
| Knowledge | Students can name the basic concepts in Stocha | astics. They are able to explain them us | ing appropriate | examples. |
| | Students can discuss logical connections between | en these concepts. They are capable | of illustrating th | ese connections with |
| | the help of examples. | | | |
| | They know proof strategies and can reproduce t | hem. | | |
| Skills | | | | |
| | Students can model problems from stochastics | | d in this course | . Moreover, they are |
| | capable of solving them by applying established | | nte etudiod in the | COURCO |
| | Students are able to discover and verify further For a given problem, the students can developed and the students of the stu | - | | |
| | results. | p and execute a suitable approach, a | | |
| Personal Competence | | | | |
| Social Competence | - Chudanta are able to work together (or an the | | by composed to | na li a taana fuan |
| | Students are able to work together (e.g. on the different study programs and background know) | | | |
| | In doing so, they can communicate new concept | | | |
| | design examples to check and deepen the unde | | | |
| | | 5 . | | |
| Autonomy | Students are capable of checking their underst | anding of complex concepts on their o | wn. They can sp | ecify open questions |
| | precisely and know where to get help in solving | | | |
| | Students can put their knowledge in relation to | the contents of other lectures. | | |
| | Students have developed sufficient persistence | e to be able to work for longer period | s in a goal-orien | ted manner on hard |
| | problems. | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 5 | 6 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 min | | | |
| scale | | | | |
| 5 | General Engineering Science (German program, 7 sem | ester): Specialisation Computer Scienc | e: Compulsory | |
| Following Curricula | | | | |
| | Data Science: Core qualification: Compulsory | tion Compulson | | |
| | Computational Science and Engineering: Core qualification Logistics and Mobility: Specialisation Engineering Science Science Science | 1 3 | | |
| | Logistics and Mobility: Specialisation Engineering Scient Logistics and Mobility: Specialisation Information Tech | 1 3 | | |
| | Theoretical Mechanical Engineering: Core qualification | | | |
| | Engineering and Management - Major in Logistics and | | hnology: Elective | Compulsory |
| | | | 3, | . , |

| Course L0777: Stochastics | |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. Matthias Schulte |
| Language | DE/EN |
| Cycle | SoSe |
| Content | 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 Multivariate distributions Law of large numbers and central limit theorem Basic notions of stochastic processes Basic concepts of statistics (point estimators, confidence intervals, hypothesis testing) |
| Literature | Methoden der statistischen Inferenz, Likelihood und Bayes, Held, L., Spektrum 2008 Stochastik für Informatiker, Dümbgen, L., Springer 2003 Statistik: Der Weg zur Datenanalyse, Fahrmeir, L., Künstler R., Pigeot, I, Tutz, G., Springer 2010 Stochastik, Georgii, HO., deGruyter, 2009 Probability and Random Processes, Grimmett, G., Stirzaker, D., Oxford University Press, 2001 Programmieren mit R, Ligges, U., Springer 2008 |

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

| Module M0675: Introd | luction to Communications and | Random Processes | | |
|-----------------------------------|---|---|-------------------|-----------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Introduction to Communications an | d Random Processes (L0442) | Lecture | 3 | 4 |
| Introduction to Communications an | d Random Processes (L0443) | Recitation Section (large) | 1 | 1 |
| Introduction to Communications an | d Random Processes (L2354) | Recitation Section (small) | 1 | 1 |
| Module Responsible | Prof. Gerhard Bauch | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mathematics 1.2 | | | |
| Knowledge | Mathematics 1-3 | | | |
| | Signals and Systems | | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students know and understand the funda- | amental building blocks of a communications s | ystem. They can | describe and analyse |
| | the individual building blocks using knowledge | e of signal and system theory as well as the t | heory of stochast | ic processes. The are |
| | aware of the essential resources and evaluate | ion criteria of information transmission and ar | e able to design | and evaluate a basic |
| | communications system. | | | |
| Skills | The students are able to design and evaluate | ate a basic communications system. In partic | ular, they can e | stimate the required |
| | resources in terms of bandwidth and power. | They are able to assess essential evaluation p | arameters of a b | asic communications |
| | system such as bandwidth efficiency or bit error rate and to decide for a suitable transmission method. | | | |
| Personal Competence | | | | |
| Social Competence | The students can jointly solve specific proble | ms. | | |
| Autonomy | The students are able to acquire relevant | information from appropriate literature sour | ces. They can c | ontrol their level o |
| | knowledge during the lecture period by solvin | g tutorial problems, software tools, clicker syst | em. | |
| Workload in Hours | Independent Study Time 110, Study Time in L | ecture 70 | | |
| 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 Electrical Engine | ering: Compulsor | у |
| Following Curricula | Computer Science: Specialisation Computer a | nd Software Engineering: Elective Compulsory | | |
| | Computer Science: Specialisation Computatio | nal Mathematics: Elective Compulsory | | |
| | Data Science: Core qualification: Elective Con | npulsory | | |
| | Electrical Engineering: Core qualification: Con | npulsory | | |
| | | n, 7 semester): Specialisation Electrical Enginee | ering: Compulsory | , |
| | Computational Science and Engineering: Core | | , | |
| | Technomathematics: Specialisation III. Engine | | | |

| Course L0442: Introduction t | co Communications and Random Processes |
|------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| | Prof. Gerhard Bauch |
| Language | |
| Cycle 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. |
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| Course L0443: Introduction to Communications and Random Processes | | |
|---|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 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 | urse L2354: Introduction to 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 | | | |

| Courses | |
|--|---|
| Title Practical Course IIW (L2160) | TypHrs/wkCPProject-/problem-based Learning86 |
| Module Responsible | Prof. Görschwin Fey |
| Admission Requirements | None |
| Recommended Previous | Successful participation in the modules: |
| Knowledge | |
| | Procedural Programming |
| | Algorithms and Data Structures |
| | Embedded Systems |
| | Computer Engineering |
| Educational Objectives | After taking part successfully, students have reached the following learning results |
| Professional Competence | |
| Knowledge | Students get to know tools used by development teams to |
| | • plan development flows, |
| | manage task distribution, |
| | manage source code, and |
| | test software. |
| Skills | Students work in teams on a larger project. The required competences are learned and practically applied. These are for example |
| | specifying software based on user requirements |
| | creating a software architecture |
| | implementing and testing software in a team, and |
| | using the related development tools. |
| Personal Competence | |
| Social Competence | Team work has its own challenges with respect to interaction of team members as well as finding the necessary agreement dur |
| | joint software development. During the project students learn the required competences and experience the practical needs. |
| Autonomy | During team work it is mandatory to take and explain a certain position, to independently complete assigned tasks, and to pres |
| | results to the team. Open issues must be identified and returned into the team to find an agreed resolution. |
| | |
| | |
| | Independent Study Time 68, Study Time in Lecture 112 |
| Credit points | |
| Course achievement | |
| | Subject theoretical and practical work |
| | Evaluation of engagement, project report and final presentation |
| scale | Computational Science and Engineering: Core qualification: Computers |
| Assignment for the | Computational Science and Engineering: Core qualification: Compulsory |

| Course L2160: Practical Cour | Course L2160: Practical Course IIW | | | | |
|------------------------------|--|--|--|--|--|
| Тур | Project-/problem-based Learning | | | | |
| Hrs/wk | 8 | | | | |
| CP | 6 | | | | |
| Workload in Hours | Independent Study Time 68, Study Time in Lecture 112 | | | | |
| Lecturer | NN, Dozenten des SD E | | | | |
| Language | DE/EN | | | | |
| Cycle | WiSe | | | | |
| Content | A software program, an embedded system or cyber physical system is developed during the course of the project. The respective lecturer provides the concrete task description. Participating students work as a team to solve the task. This induces a typical project flow as it occurs in enterprises as well. Typical steps like defining a specification, creating a hardware-software-architecture as well as implementation and testing are mandatory. Students are also responsible for project planning, defining and assigning sub tasks to team members. Common development tools supporting planning, management and realization are used within the project. The project is split into regular plenary sessions and into independent team work. | | | | |
| Literature | Wird durch die jeweiligen DozentInnen zur Verfügung gestellt. Supplied by the respective lecturer. | | | | |

| | duction to Control Systems | | | |
|---|--|---|--|---|
| Courses | | | | |
| Fitle | Тур | | Hrs/wk | СР |
| ntroduction to Control Systems (L ntroduction to Control Systems (L(| | on (small) | 2 2 | 4 2 |
| Module Responsible | | 511 (5111011) | 2 | 2 |
| Admission Requirements | | | | |
| | Representation of signals and systems in time and frequency domain, Laplace tra | ansform | | |
| Knowledge | | | | |
| | | | | |
| Educational Objectives | After taking part successfully, students have reached the following learning result | lts | | |
| Professional Competence | | | | |
| Knowledge | Students can represent dynamic system behavior in time and frequency of | domain, and car | n in particular | explain properties |
| | first and second order systems | | | |
| | They can explain the dynamics of simple control loops and interpret dynamics | mic properties i | n terms of free | quency response ar |
| | root locusThey can explain the Nyquist stability criterion and the stability margins d | larivad from it | | |
| | They can explain the role of the phase margin in analysis and synthesis of | | | |
| | • They can explain the way a PID controller affects a control loop in terms of | | esponse | |
| | They can explain issues arising when controllers designed in continuous ti | ime domain are | implemented | digitally |
| Skills | | | | |
| | Students can transform models of linear dynamic systems from time to free | equency domain | and vice vers | a |
| | They can simulate and assess the behavior of systems and control loops They can design PID controllers with the help of heuristic (Ziegler-Nichols) | tuning rulos | | |
| | They can analyze and synthesize simple control loops with the help of root | | uency respons | e techniques |
| | • They can calculate discrete-time approximations of controllers design | | | |
| | implementation | | | |
| | They can use standard software tools (Matlab Control Toolbox, Simulink) for | or carrying out I | these tasks | |
| Personal Competence | | | | |
| Social Competence | Students can work in small groups to jointly solve technical problems, and exper | imentally valida | te their contro | ller designs |
| Autonomy | Students can obtain information from provided sources (lecture notes, software | re documentati | on, experimer | t quides) and use |
| | | | | ie galaes, and ase |
| | when solving given problems. | | | in galaco, alla acc |
| | when solving given problems. They can assess their knowledge in weekly on-line tests and thereby control thei | | | galacs, and ase |
| | | | | |
| | | | | |
| | | | | , guuss, und use |
| Workload in Hours | | | | |
| Credit points | They can assess their knowledge in weekly on-line tests and thereby control thei Independent Study Time 124, Study Time in Lecture 56 6 | | | |
| Credit points Course achievement | They can assess their knowledge in weekly on-line tests and thereby control thei Independent Study Time 124, Study Time in Lecture 56 6 None | | | |
| Credit points Course achievement Examination | They can assess their knowledge in weekly on-line tests and thereby control their Independent Study Time 124, Study Time in Lecture 56 6 None Written exam | | | |
| Credit points Course achievement Examination Examination duration and | They can assess their knowledge in weekly on-line tests and thereby control their Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min | | | |
| Credit points Course achievement Examination Examination duration and scale | They can assess their knowledge in weekly on-line tests and thereby control their Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min | ir learning progr | | |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-line tests and thereby control their Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: | ir learning progr | | |
| Credit points Course achievement Examination Examination duration and scale | They can assess their knowledge in weekly on-line tests and thereby control their Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: Bioprocess Engineering: Core qualification: Compulsory | ir learning progr | | |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-line tests and thereby control their Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: | ir learning progr | | |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-line tests and thereby control thei Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compuls | ir learning progr | | |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-line tests and thereby control thei Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulss Data Science: Core qualification: Elective Compulsory | ir learning progr | | |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-line tests and thereby control their Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulss Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Elective | ir learning progr Compulsory ory | ess. | |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-line tests and thereby control their Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulss Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Elective General Engineering Science (English program, 7 semester): Specialisation Elective General Engineering Science (English program, 7 semester): Specialisation Civil I | ir learning progr Compulsory ory rical Engineering: Co | ess. | |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-line tests and thereby control their Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulss Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electiv General Engineering Science (English program, 7 semester): Specialisation Civil I General Engineering Science (English program, 7 semester): Specialisation Electiv | ir learning progr Compulsory ory rical Engineering: Co rocess Engineeri | ess. | γ |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-line tests and thereby control their Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulss Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Elective General Engineering Science (English program, 7 semester): Specialisation Elective General Engineering Science (English program, 7 semester): Specialisation Civil I | ir learning progr Compulsory ory rical Engineering Engineering: Co rocess Engineeri gy and Envirome | ess. | γ |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-line tests and thereby control their Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulss Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electiv General Engineering Science (English program, 7 semester): Specialisation Civil I General Engineering Science (English program, 7 semester): Specialisation Biopr General Engineering Science (English program, 7 semester): Specialisation Biopr General Engineering Science (English program, 7 semester): Specialisation Biopr | ir learning progr Compulsory ory rical Engineering Engineering: Co rocess Engineeri gy and Envirome puter Science: C | ess. | γ ing: Compulsory |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-line tests and thereby control their Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulss Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electiv General Engineering Science (English program, 7 semester): Specialisation Electiv General Engineering Science (English program, 7 semester): Specialisation Electiv General Engineering Science (English program, 7 semester): Specialisation Energ General Engineering Science (English program, 7 semester): Specialisation Comp General Engineering Science (English program, 7 semester): Specialisation Comp | ir learning progr Compulsory ory rical Engineering Engineering: Co rocess Engineeri gy and Envirome puter Science: Co n Mechanical E | g: Compulsory mpulsory ng: Compulsory ental Engineer ompulsory ingineering, F | ry ing: Compulsory rocus Biomechanic |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-line tests and thereby control their Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulss Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electiv General Engineering Science (English program, 7 semester): Specialisation Electiv General Engineering Science (English program, 7 semester): Specialisation Electiv General Engineering Science (English program, 7 semester): Specialisation Comp General Engineering Science (English program, 7 semester): Specialisation Comp | ir learning progr Compulsory ory rical Engineering Engineering: Co rocess Engineeri gy and Envirome puter Science: Co n Mechanical E | g: Compulsory mpulsory ng: Compulsory ental Engineer ompulsory ingineering, F | ry ing: Compulsory rocus Biomechanic |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-line tests and thereby control their Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulss Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electiv General Engineering Science (English program, 7 semester): Specialisation Electiv General Engineering Science (English program, 7 semester): Specialisation Energ General Engineering Science (English program, 7 semester): Specialisation Comp General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory | ir learning progr Compulsory ory rical Engineering Engineering: Co rocess Engineeri gy and Envirome puter Science: Co n Mechanical Eng Mechanical Eng | ess. | ry ing: Compulsory iocus Biomechanic us Energy System |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-line tests and thereby control their Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulss Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electiv General Engineering Science (English program, 7 semester): Specialisation Electiv General Engineering Science (English program, 7 semester): Specialisation Electiv General Engineering Science (English program, 7 semester): Specialisation Comp General Engineering Science (English program, 7 semester): Specialisation Comp | ir learning progr Compulsory ory rical Engineering Engineering: Co rocess Engineeri gy and Envirome puter Science: Co n Mechanical Eng Mechanical Eng | ess. | ry ing: Compulsory iocus Biomechanic us Energy System |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-line tests and thereby control their Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulss Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electiv General Engineering Science (English program, 7 semester): Specialisation Electiv General Engineering Science (English program, 7 semester): Specialisation Energy General Engineering Science (English program, 7 semester): Specialisation Comp General Engineering Science (English program, 7 semester): Specialisation Comp General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation | ir learning progr Compulsory ory rical Engineering Engineering: Co rocess Engineeri gy and Envirome puter Science: C n Mechanical Eng Mechanical Eng | ess. | ry ing: Compulsory focus Biomechanic us Energy System us Aircraft Systen |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-line tests and thereby control their Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulss Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electu General Engineering Science (English program, 7 semester): Specialisation Electu General Engineering Science (English program, 7 semester): Specialisation Elector General Engineering Science (English program, 7 semester): Specialisation Elector General Engineering Science (English program, 7 semester): Specialisation Comp General Engineering Science (English program, 7 semester): Specialisation Comp General Engineering Science (English program, 7 semester): Specialisation Comp General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation | ir learning progr Compulsory ory rical Engineering Engineering: Co rocess Engineeri gy and Envirome puter Science: C n Mechanical Eng Mechanical Eng | ess. | ry ing: Compulsory focus Biomechanic us Energy System us Aircraft Systen |
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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 tests and thereby control their Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulss Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Electiv General Engineering Science (English program, 7 semester): Specialisation Elect General Engineering Science (English program, 7 semester): Specialisation Elect General Engineering Science (English program, 7 semester): Specialisation Energ General Engineering Science (English program, 7 semester): Specialisation Comp General Engineering Science (English program, 7 semester): Specialisation Comp General Engineering Science (English program, 7 semester): Specialisation Comp General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Engineering Science (English program, 7 semester): Specialisation Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Engineering Science (English program, 7 semester): Specialisation Engineering Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mech Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mech Sciences: Compulsory | ir learning progr Compulsory ory rical Engineering Engineering: Co rocess Engineeri gy and Envirome puter Science: C n Mechanical Eng Mechanical Eng nanical Engineer n Mechanical I | ess. | ry ing: Compulsory focus Biomechanic us Energy System us Aircraft Systen terials in Engineerir Focus Mechatronic |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-line tests and thereby control their Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulss Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Elective General Engineering Science (English program, 7 semester): Specialisation Comp General Engineering Science (English program, 7 semester): Specialisation Comp General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mech Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mech Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mech Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mech Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory | ir learning progr Compulsory ory rical Engineering Engineering: Co rocess Engineeri gy and Envirome puter Science: C n Mechanical Eng Mechanical Eng nanical Engineer n Mechanical I | ess. | ry ing: Compulsory focus Biomechanic us Energy System us Aircraft Systen terials in Engineerir Focus Mechatronic |
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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 tests and thereby control their Independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulss Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Energy and Environmental Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Elective General Engineering Science (English program, 7 semester): Specialisation Comp General Engineering Science (English program, 7 semester): Specialisation Comp General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mech Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mech Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mech Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mech Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory | ir learning progr Compulsory ory rical Engineering Engineering: Co rocess Engineeri gy and Envirome puter Science: C n Mechanical Engineer Mechanical Engineer n Mechanical Ingineer n Mechanical Ingineer | ess. | ry ing: Compulsory focus Biomechanic us Energy System us Aircraft Systen terials in Engineerir Focus Mechatronic froduct Developme |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | They can assess their knowledge in weekly on-line tests and thereby control their independent Study Time 124, Study Time in Lecture 56 6 None Written exam 120 min General Engineering Science (German program, 7 semester): Core qualification: Bioprocess Engineering: Core qualification: Compulsory Computer Science: Specialisation Computational Mathematics: Elective Compulss Data Science: Core qualification: Elective Compulsory Electrical Engineering: Core qualification: Compulsory Electrical Engineering: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Elect General Engineering Science (English program, 7 semester): Specialisation Comp General Engineering Science (English program, 7 semester): Specialisation Comp General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Engineering: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mech Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Compulsory General Engineering Science (English program, 7 semester): Specialisation Mech Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mech Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mech Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mech Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mech Sciences: Compulsory General Engineering Science (English program, 7 semester): Specialisation Mec | ir learning progr Compulsory ory rical Engineering Engineering: Co rocess Engineeri gy and Envirome puter Science: C n Mechanical Engineer Mechanical Engineer n Mechanical Ingineer n Mechanical Ingineer n Mechanical Ingineer hanical Enginee | ess. | ry ing: Compulsory focus Biomechanic us Energy System us Aircraft Systen terials in Engineerir Focus Mechatronic froduct Developme |

| 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 plots |
| | Root locus design of PID controllers |
| | Frequency response techniques |
| | Bode diagram Minimum and non-minimum phase systems Nyquist plot, Nyquist stability criterion, phase and gain margin Loop shaping, lead lag compensation Frequency response interpretation of PID control |
| | Time delay systems |
| | Root locus and frequency response of time delay 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 | Course L0655: Introduction to Control Systems | | |
|------------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Herbert Werner | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

Specialization I. Computer Science

| Module M0731: Funct | ional Program | ning | | | | |
|--------------------------------|--|----------------------------------|---|--|---|--|
| 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 |
| Module Responsible | Prof. Sibylle Schupp | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Discrete mathematics | s at high-school | level | | | |
| Knowledge | | | | | | |
| Educational Objectives | After taking part succ | essfully, studen | ts have reached the follo | owing learning results | | |
| Professional Competence | | | | | | |
| Knowledge | to read Haskell progr errors in programs. T | ams and to exp They apply the | lain Haskell syntax as w fundamental data struct | techniques of functional prograr ell as Haskell's read-eval-print l ures, data types, and type con and total correctness. They dist | oop. They interposite structors. They e | ret warnings and find employ strategies for |
| Skills | Students break a natural-language description down in parts amenable to a formal specification and develop a functional program in a structured way. They assess different language constructs, make conscious selections both at specification and implementations level, and justify their choice. They analyze given programs and rewrite them in a controlled way. They design and implement unit tests and can assess the quality of their tests. They argue for the correctness of their program. | | | | | |
| Personal Competence | | | | | | |
| Social Competence | Students practice per programs orally. They | | | ney explain problems and solut | ions to their pee | er. They defend their |
| Autonomy | | | | k.a. "Betreutes Programmieren' htly, and receive feedback. | ') the mechanics | of programming. Ir |
| Workload in Hours | Independent Study Ti | me 96, Study Ti | me in Lecture 84 | | | |
| Credit points | 6 | | | | | |
| Course achievement | Compulsory Bonus | Form | Description | | | |
| | Yes 15 % | Excercises | | | | |
| Examination | Written exam | | | | | |
| Examination duration and | 90 min | | | | | |
| scale | | | | | | |
| Assignment for the | General Engineering S | Science (Germa | n program, 7 semester): | Specialisation Computer Science | e: Elective Comp | ulsory |
| Following Curricula | Computer Science: Co | | | | | |
| | Data Science: Core qu | | | | | |
| | | • | lechatronics: Elective Co | | | |
| | | - | | Specialisation Computer Science | | |
| | | | | Specialisation Mechatronics: Ele | | |
| | | - | | nputer Science: Elective Compul | sory | |
| | Technomathematics: | Specialisation II | . Informatics: Elective Co | ompulsory | | |

| Course L0624: Functional Pro | ogramming |
|------------------------------|---|
| Тур | Lecture |
| 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. |

| Course L0625: Functional Pre | ogramming | | |
|------------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | | | |
| CP | 2 | | |
| Workload in Hours | dependent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | of. Sibylle Schupp | | |
| Language | Ν | | |
| Cycle | WiSe | | |
| Content | Functions, Currying, Recursive Functions, Polymorphic Functions, Higher-Order Functions Conditional Expressions, Guarded Expressions, Pattern Matching, Lambda Expressions Types (simple, composite), Type Classes, Recursive Types, Algebraic Data Type Type Constructors: Tuples, Lists, Trees, Associative Lists (Dictionaries, Maps) Modules Interactive Programming Lazy Evaluation, Call-by-Value, Strictness Design Recipes Testing (axiom-based, invariant-based, against reference implementation) Reasoning about Programs (equation-based, inductive) Idioms of Functional Programming Haskell Syntax and Semantics | | |
| Literature | Graham Hutton, Programming in Haskell, Cambridge University Press 2007. | | |

| Course L0626: Functional Press | ogramming |
|--------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Sibylle Schupp |
| Language | EN |
| Cycle | WiSe |
| Content | Functions, Currying, Recursive Functions, Polymorphic Functions, Higher-Order Functions Conditional Expressions, Guarded Expressions, Pattern Matching, Lambda Expressions Types (simple, composite), Type Classes, Recursive Types, Algebraic Data Type Type Constructors: Tuples, Lists, Trees, Associative Lists (Dictionaries, Maps) Modules Interactive Programming Lazy Evaluation, Call-by-Value, Strictness Design Recipes Testing (axiom-based, invariant-based, against reference implementation) Reasoning about Programs (equation-based, inductive) Idioms of Functional Programming Haskell Syntax and Semantics |
| Literature | Graham Hutton, Programming in Haskell, Cambridge University Press 2007. |

| Module M0972: Distri | buted Systems | | | |
|--|--|---|------------------------------------|--|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Distributed Systems (L1155) Distributed Systems (L1156) | | Lecture Recitation Section (small) | 2 | 3 |
| Module Responsible | Prof Volker Turau | Reclation Section (small) | Z | 5 |
| | None | | | |
| Recommended Previous Knowledge | Procedural programming Object-oriented programming with Java Networks Socket programming | | | |
| Educational Objectives | After taking part successfully, students have reach | ned the following learning results | | |
| | Students explain the main abstractions of Distr synchron/asynchron system). They describe the examples of existing middleware solutions. The systems, including their pros and cons. Students of Students can realize distributed systems using at • Proprietary protocol realized with TCP • HTTP as a remote procedure call • RMI as a middleware | pros and cons of different types of inte participants of the course know the main an describe at least three different synchron | rprocess commu architectural va | unication. They given in the second sec |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lectu | re 56 | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | | | | |
| Examination duration and scale | 120 min | | | |
| Assignment for the | Computer Science: Specialisation I. Computer and Computer Science: Specialisation Computer and S Computational Science and Engineering: Specialis | oftware Engineering: Elective Compulsory | | |
| | Technomathematics: Specialisation II. Informatics: | Elective Compulsory | | |

| Course L1155: Distributed Sy | ystems | |
|------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | | |
| CP | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Volker Turau | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Architectures for distributed systems HTTP: Simple remote procedure call Client-Server Architectures Remote procedure call Remote Method Invocation (RMI) Synchronization Distributed Caching Name servers Distributed File systems | |
| Literature | Verteilte Systeme - Prinzipien und Paradigmen, Andrew S. Tanenbaum, Maarten van Steen, Pearson Studium Verteilte Systeme, G. Coulouris, J. Dollimore, T. Kindberg, 2005, Pearson Studium | |

| Course L1156: Distributed Sy | ourse L1156: Distributed Systems | |
|------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | | |
| CP | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Volker Turau | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Engineering | | | | | | |
|-------------------------------|--|-------------------|----------------------|---------------------------------------|------------------|-------------------------|
| Module M0791: Comp | uter Architecture | | | | | |
| | | | | | | |
| Courses | | | | | | |
| Title | | | | Тур | Hrs/wk | СР |
| Computer Architecture (L0793) | | | | Lecture | 2 | 3 |
| Computer Architecture (L0794) | | | | Project-/problem-based Learning | 2 | 2 |
| Computer Architecture (L1864) | | | | Recitation Section (small) | 1 | 1 |
| Module Responsible | Prof. Heiko Falk | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Module "Computer Engineerin | g" | | | | |
| Knowledge | | | | | | |
| Educational Objectives | After taking part successfully, | students have re | eached the following | ng learning results | | |
| Professional Competence | | | | | | |
| Knowledge | This module presents advanc | ed concepts from | n the discipline of | f computer architecture. In the | beginning, a l | proad overview ove |
| | various programming models | s is given, both | for general-purp | oose computers and for specia | al-purpose ma | chines (e.g., signa |
| | processors). Next, foundationa | al aspects of the | micro-architecture | e of processors are covered. Her | e, the focus pa | articularly lies on the |
| | so-called pipelining and the m | nethods used for | the acceleration | of instruction execution used in | this context. | The students get to |
| | know concepts for dynamic scheduling, branch prediction, superscalar execution of machine instructions and for memory | | | | | |
| | hierarchies. | | | | | |
| | | | | | | |
| Skills | | - | | . They know the different archite | | |
| | models. The students examine various structures of pipelined processor architectures and are able to explain their concepts and to analyze them w.r.t. criteria like, e.g., performance or energy efficiency. They evaluate different structures of memory hierarchies, | | | | | |
| | | | | | | |
| | know parallel computer archit | ectures and are | able to distinguish | between instruction- and data-l | evel parallelisi | n. |
| Personal Competence | | | | | | |
| Social Competence | Students are able to solve sim | ilar problems alo | one or in a group a | nd to present the results accord | ingly. | |
| | | | | | | |
| 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 110, | Study Time in Le | ecture 70 | | | |
| Credit points | 6 | - | | | | |
| | Compulsory Bonus Form | | Description | | | |
| | No 15 % Subject | theoretical | and | | | |
| | practic | al work | | | | |
| Examination | Written exam | | | | | |
| Examination duration and | 90 minutes, contents of course | e and 4 attestati | ons from the PBL " | Computer architecture" | | |
| scale | | | | | | |
| Assignment for the | General Engineering Science (| German progran | n, 7 semester): Sp | ecialisation Computer Science: E | lective Compu | ulsory |
| Following Curricula | Computer Science: Specialisat | ion Computer ar | d Software Engine | eering: Elective Compulsory | | |
| | Computer Science: Specialisat | ion I. Computer | and Software Engi | neering: Elective Compulsory | | |
| | Aircraft Systems Engineering: | Core qualificatio | n: Elective Compu | Isory | | |
| | Aircraft Systems Engineering: | Specialisation A | vionic Systems: Ele | ective Compulsory | | |
| | General Engineering Science (| English program | , 7 semester): Spe | cialisation Computer Science: El | ective Compu | lsory |
| | | | | ter Science: Elective Compulsor | | - |
| | Microelectronics and Microsys | | - | | | |
| | | | | · · · · · · · · · · · · · · · · · · · | | |

| 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 | |
|---|--|
| Project-/problem-based Learning | |
| 2 | |
| 2 | |
| Independent Study Time 32, Study Time in Lecture 28 | |
| Prof. Heiko Falk | |
| DE/EN | |
| WiSe | |
| See interlocking course | |
| See interlocking course | |
| | |

| Course L1864: Computer Architecture | |
|-------------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Heiko Falk |
| Language | DE/EN |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Typ Lecture Recitation Section (small) y, Logic, and Formal Language Theory. eached the following learning results the models of computability, the class of ons, the theorems of Kleene, Rice, and Rice mi-Thue systems, Thue systems, semi-grou s of complexity theory. illity of sets and functions and to analyze the lone or in a group and to present the results | e-Shapiro, the conce ips, and Post corre | ept of decidable a spondence system |
|---|--|---|
| Lecture Recitation Section (small) y, Logic, and Formal Language Theory. eached the following learning results the models of computability, the class of ons, the theorems of Kleene, Rice, and Rice mi-Thue systems, Thue systems, semi-grou s of complexity theory. illity of sets and functions and to analyze the | 2 2 f partial recursive e-Shapiro, the concups, and Post corre | 3 3 functions, univer ept of decidable a spondence system |
| Lecture Recitation Section (small) y, Logic, and Formal Language Theory. eached the following learning results the models of computability, the class of ons, the theorems of Kleene, Rice, and Rice mi-Thue systems, Thue systems, semi-grou s of complexity theory. illity of sets and functions and to analyze the | 2 2 f partial recursive e-Shapiro, the concups, and Post corre | 3 3 functions, univer ept of decidable a spondence system |
| Recitation Section (small) y, Logic, and Formal Language Theory. eached the following learning results he models of computability, the class of ons, the theorems of Kleene, Rice, and Rice mi-Thue systems, Thue systems, semi-grou s of complexity theory. illity of sets and functions and to analyze the | 2 f partial recursive e-Shapiro, the concups, and Post corre e complexity of comp | 3 functions, univer ept of decidable a spondence system |
| y, Logic, and Formal Language Theory. Eached the following learning results the models of computability, the class of ons, the theorems of Kleene, Rice, and Rice mi-Thue systems, Thue systems, semi-grou s of complexity theory. illity of sets and functions and to analyze the | f partial recursive e-Shapiro, the conc ups, and Post corre e complexity of comp | functions, univer ept of decidable a spondence system |
| eached the following learning results the models of computability, the class of ons, the theorems of Kleene, Rice, and Rice mi-Thue systems, Thue systems, semi-grou s of complexity theory. illity of sets and functions and to analyze the | e-Shapiro, the conce ips, and Post corre | ept of decidable a spondence system |
| eached the following learning results the models of computability, the class of ons, the theorems of Kleene, Rice, and Rice mi-Thue systems, Thue systems, semi-grou s of complexity theory. illity of sets and functions and to analyze the | e-Shapiro, the conce ips, and Post corre | ept of decidable a spondence system |
| eached the following learning results the models of computability, the class of ons, the theorems of Kleene, Rice, and Rice mi-Thue systems, Thue systems, semi-grou s of complexity theory. illity of sets and functions and to analyze the | e-Shapiro, the conce ips, and Post corre | ept of decidable a spondence system |
| he models of computability, the class of ons, the theorems of Kleene, Rice, and Rice mi-Thue systems, Thue systems, semi-grou s of complexity theory. illity of sets and functions and to analyze the | e-Shapiro, the conce ips, and Post corre | ept of decidable a spondence system |
| he models of computability, the class of ons, the theorems of Kleene, Rice, and Rice mi-Thue systems, Thue systems, semi-grou s of complexity theory. illity of sets and functions and to analyze the | e-Shapiro, the conce ips, and Post corre | ept of decidable a spondence system |
| ons, the theorems of Kleene, Rice, and Rice mi-Thue systems, Thue systems, semi-grou s of complexity theory. ility of sets and functions and to analyze the | e-Shapiro, the conce ips, and Post corre | ept of decidable a spondence system |
| ons, the theorems of Kleene, Rice, and Rice mi-Thue systems, Thue systems, semi-grou s of complexity theory. ility of sets and functions and to analyze the | e-Shapiro, the conce ips, and Post corre | ept of decidable a spondence system |
| mi-Thue systems, Thue systems, semi-grou s of complexity theory. ility of sets and functions and to analyze the | e complexity of comp | spondence system |
| s of complexity theory. ility of sets and functions and to analyze the | e complexity of comp | |
| ility of sets and functions and to analyze the | | putable functions. |
| | | putable functions. |
| | | putable functions. |
| one or in a group and to present the results | accordingly. | |
| one or in a group and to present the results | accordingly. | |
| | | |
| | | |
| rom newer literature and to associate the acc | quired knowledge w | ith other classes. |
| ecture 56 | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| n, 7 semester): Specialisation Computer Scie | ence: Elective Comp | ulsory |
| | | 5 |
| | | |
| · · | nce: Elective Compu | Ilsory |
| | | |
| | | |
| F | sory pulsory | , 7 semester): Specialisation Computer Science: Elective Compu |

| Course L0166: Computability | 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 | ating Systems | | | |
|---------------------------------------|--|---|-----------------|--------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Operating Systems (L1153) | | Lecture | 2 | 3 |
| Operating Systems (L1154) | | Recitation Section (small) | 2 | 3 |
| Module Responsible | | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Object-oriented programming, algorithms, and d Procedural programming Experience in using tools related to operating sy Experience in using C-libraries | | rs | |
| Educational Objectives | After taking part successfully, students have reached the | ne following learning results | | |
| Professional Competence | | | | |
| | Students explain the main abstractions process, virtual memory, deadlock, lifelock, and file of operations systems, describe the process states and their transitions, and paraphrase the architectural variants of operating systems. They give examples of existing operating systems and explain their architectures. The participants of the course write concurrent programs using threads, conditional variables and semaphores. Students can describe the variants of realizing a file system. Students explain at least three different scheduling algorithms. Students are able to use the POSIX libraries for concurrent programming in a correct and efficient way. They are able to judge the efficiency of a scheduling algorithm for a given scheduling task in a given environment. | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | | | | |
| · · · · · · · · · · · · · · · · · · · | Independent Study Time 124, Study Time in Lecture 56 | · · · · · · · · · · · · · · · · · · · | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 seme | ester): Specialisation Computer Science | : Elective Comp | ulsory |
| Following Curricula | Computer Science: Specialisation I. Computer and Soft | ware Engineering: Elective Compulsory | | |
| | General Engineering Science (English program, 7 seme | ster): Specialisation Computer Science | Elective Compu | lsory |
| | Computational Science and Engineering: Specialisation | I. Computer Science: Elective Compuls | ory | |
| | Technomathematics: Specialisation II. Informatics: Elec | tive Compulsory | | |

| Course L1153: Operating Systems | | |
|---------------------------------|---|--|
| Тур | ecture | |
| 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 | Architectures for Operating Systems Processes Concurrency Deadlocks Memory organization Scheduling File systems | |
| Literature | Operating Systems, William Stallings, Pearson International Edition Moderne Betriebssysteme, Andrew Tanenbaum, Pearson Studium | |

| Course L1154: Operating Systems | |
|---------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| 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 |

| Module M0754: Comp | iler Construction | | | |
|-------------------------------|--|---|--------------------|--------------------|
| Courses | | | | |
| Fitle | | Тур | Hrs/wk | СР |
| Compiler Construction (L0703) | | Lecture | 2 | 2 |
| Compiler Construction (L0704) | | Recitation Section (small) | 2 | 4 |
| Module Responsible | Prof. Sibylle Schupp | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | Practical programming experience | | | |
| 2 | Automata theory and formal languages | | | |
| | Functional programming or procedural programming | amming | | |
| | Object-oriented programming, algorithms, an | d data structures | | |
| | Basic knowledge of software engineering | | | |
| Educational Objectives | After taking part successfully, students have reache | d the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students explain the workings of a compiler and b | reak down a compilation task in different | phases. They a | pply and modify th |
| | major algorithms for compiler construction and code | | | |
| | run and test them. They choose appropriate intern | | | |
| | | | - | |
| | modify implementations of existing compiler frameworks and experiment with frameworks and tools. | | | |
| Skills | s Students design and implement arbitrary compilation phases. They integrate their code in existing compiler frameworks. Th | | er frameworks. The | |
| | organize their compiler code properly as a software project. They generalize algorithms for compiler construction to algorithm | | | |
| | that analyze or synthesize software. | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| , | their software in class. They communicate in English | | | |
| | | | | |
| Autonomy | Students develop their software independently and | define milestones by themselves. They re | ceive feedback t | hroughout the enti |
| | project. They organize the software project so that they can assess their progress themselves. | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Subject theoretical and practical work | | | |
| Examination duration and | Software (Compiler) | | | |
| scale | | | | |
| Assignment for the | Computer Science: Specialisation Computer and Sof | tware Engineering: Elective Compulsory | | |
| Following Curricula | Computer Science: Specialisation I. Computer and S | oftware Engineering: Elective Compulsory | | |
| - | Computational Science and Engineering: Specialisat | ion I. Computer Science: Elective Compuls | ory | |
| | Technomathematics: Specialisation II. Informatics: E | | - | |

| Course L0703: Compiler Construction | | |
|-------------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Sibylle Schupp | |
| Language | EN | |
| Cycle | SoSe | |
| Content | Lexical and syntactic analysis Semantic analysis High-level optimization Intermediate languages and code generation Compilation pipeline | |
| | Alfred Aho, Jeffrey Ullman, Ravi Sethi, and Monica S. Lam, Compilers: Principles, Techniques, and Tools, 2nd edition Aarne Ranta, Implementing Programming Languages, An Introduction to Compilers and Interpreters, with an appendix coauthored by Markus Forsberg, College Publications, London, 2012 | |

| Course L0704: Compiler Construction | |
|-------------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| CP | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. Sibylle Schupp |
| Language | EN |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Lingineering | | | | |
|------------------------------|---|---|---------------------|----------------------|
| Module M0732: Softw | vare Engineering | | | |
| | | | | |
| Title | | Тур | Hrs/wk | СР |
| Software Engineering (L0627) | | Lecture | 2 | 3 |
| Software Engineering (L0628) | | Recitation Section (small) | 2 | 3 |
| Module Responsible | Prof. Sibylle Schupp | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Automata theory and formal languages | | | |
| Knowledge | Procedural programming or Functional programm | aing | | |
| | Object-oriented programming, algorithms, and d | - | | |
| | • Object-oriented programming, algorithms, and u | | | |
| Educational Objectives | After taking part successfully, students have reached the | ne following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students explain the phases of the software life of | cycle, describe the fundamental ter | minology and co | oncepts of software |
| | engineering, and paraphrase the principles of structure | d software development. They give ex | amples of softwa | re-engineering tasks |
| | of existing large-scale systems. They write test case | s for different test strategies and d | evise specificatio | ns or models using |
| | different notations, and critique both. They explain s | imple design patterns and the majo | r activities in rec | uirements analysis, |
| | maintenance, and project planning. | | | |
| | | | | |
| Skills | For a given task in the software life cycle, students identify the corresponding phase and select an appropriate method. They | | | |
| | choose the proper approach for quality assurance. They design tests for realistic systems, assess the quality of the tests, and find | | | |
| | errors at different levels. They apply and modify non-executable artifacts. They integrate components based on interface | | | |
| | specifications. | | | |
| Personal Competence | | | | |
| | Students practice peer programming. They explain problems and solutions to their peer. They communicate in English. | | | |
| | · · · · · · · · · · · · · · · · · · · | | | 5 |
| Autonomy | Using on-line quizzes and accompanying material for | self study, students can assess their | level of knowled | ge continuously and |
| | adjust it appropriately. Working on exercise problems, | they receive additional feedback. | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | | | | |
| Course achievement | * | ription | | |
| course demovement | Yes 15 % Excercises | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| | General Engineering Science (German program, 7 seme | ester): Specialisation Computer Science | e: Elective Comp | Ilsorv |
| Following Curricula | General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory Computer Science: Core qualification: Compulsory | | | |
| i ononing carricula | Computer Science: Core qualification: Compulsory General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Compulsory | | | |
| | Computational Science and Engineering: Specialisation | | | 5013 |
| | Technomathematics: Specialisation II. Informatics: Elect | | SOLA | |
| L | recimomaticinatics. specialisation n. molfillatics. Elec | ave compusory | | |

| Course L0627: Software Engineering | | |
|------------------------------------|---|--|
| 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 Engineering | |
|------------------------------------|---|
| 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 |

| Module M1300: Software Development | | | |
|--|--|---|---|
| Courses | | | |
| Title Software Developm Software Developm | | Typ Project-/problem-based Learning Lecture | Hrs/wk CP 2 5 1 1 |
| Module Responsible | Prof. Sibylle Schupp | | |
| Admission Requirements | None | | |
| Recommended Previous Knowledge | Introduction to Software Engineering Programming Skills Experience with Developing Small to Medium-Size Programming Statement (Statement (| grams | |
| Educational Objectives | After taking part successfully, students have reached the follo | owing learning results | |
| Professional Competence Knowledge | Students explain the fundamental concepts of ag test-driven development, and explain how contin different scenarios. They give examples of select regarding scalability and other non-functional rec build scripts and combine them in a correspondir environment. They explain major activities in req program comprehension, and agile project develo | uous integration can be used in ted pitfalls in software development, quirements. They write unit tests and ng integration quirements analysis, | |
| Skills | For a given task on a legacy system, students identify the corresponding parts in the system and select an appropriate method for understanding the details. They choose the proper approach of splitting a task in independent testable and extensible pieces and, thus, solve the task with proper methods for quality assurance. They design tests for legacy systems, create automated builds, and find errors at different levels. They integrate the resulting artifacts in a continuous development environment | | |
| Personal Competence Social Competence Autonomy | / Students discuss different design decisions in a group. They defend their solutions orally. They communicate in English. | | |
| Workload in Hours | Independent Study Time 138, Study Time in Lecture 42 | | |
| Credit points | 6 | | |
| Course achievement | None | | |
| Examination | Subject theoretical and practical work | | |
| Examination | Software | | |
| duration and | | | |
| scale | | | |
| Assignment | Computer Science: Specialisation I. Computer and Software E | | |
| for the Following Curricula | Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory Computational Science and Engineering: Specialisation I. Computer Science: Elective Compulsory | | |

| Course L1790: Software Development | | |
|------------------------------------|--|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 2 | |
| CP | 5 | |
| Workload in Hours | Independent Study Time 122, Study Time in Lecture 28 | |
| Lecturer | Prof. Sibylle Schupp | |
| Language | EN | |
| Cycle | SoSe | |
| Content | Agile Methods Test-Driven Development and Unit Testing Continuous Integration Web Services Scalability From Defects to Failure | |
| Literature | Duvall, Paul M. Continuous Integration. Pearson Education India, 2007. Humble, Jez, and David Farley. Continuous delivery: reliable software releases through build, test, and deployment automation. Pearson Education, 2010. Martin, Robert Cecil. Agile software development: principles, patterns, and practices. Prentice Hall PTR, 2003. http://scrum-kompakt.de/ Myers, Glenford J., Corey Sandler, and Tom Badgett. The art of software testing. John Wiley & Sons, 2011. | |

| Course L1789: Software Development | | |
|------------------------------------|--|--|
| Тур | Typ Lecture | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Sibylle Schupp | |
| Language | EN | |
| Cycle | SoSe | |
| Content | Agile Methods Test-Driven Development and Unit Testing Continuous Integration Web Services Scalability From Defects to Failure | |
| Literature | Duvall, Paul M. Continuous Integration. Pearson Education India, 2007. Humble, Jez, and David Farley. Continuous delivery: reliable software releases through build, test, and deployment automation. Pearson Education, 2010. Martin, Robert Cecil. Agile software development: principles, patterns, and practices. Prentice Hall PTR, 2003. http://scrum-kompakt.de/ Myers, Glenford J., Corey Sandler, and Tom Badgett. The art of software testing. John Wiley & Sons, 2011. | |

Specialization II. Mathematics & Engineering Science

| Module M1235: Election | rical Power Systems I: Introduction to | Electrical Power Systems | | |
|-----------------------------|--|---|--------------------|-----------------------|
| | | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| | ction to Electrical Power Systems (L1670) | Lecture | 3 | 4 |
| | ction 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 reached t | he following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to give an overview of conventional a evaluate technologies of electric power generation, tra electric power systems. | | | - |
| Skills | With completion of this module the students are able to apply the acquired skills in applications of the design, integration, development of electric power systems and to assess the results. | | | |
| Personal Competence | | | | |
| Social Competence | The students can participate in specialized and interdisciplinary discussions, advance ideas and represent their own work results in front of others. | | | r own work results in |
| Autonomy | Students can independently tap knowledge of the emp | hasis of the lectures. | | |
| 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 - 150 minutes | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 sem | ester): Specialisation Electrical Enginee | ering: Elective Co | mpulsory |
| Following Curricula | General Engineering Science (German program, 7 sem | ester): Specialisation Green Technologi | es, Focus Renew | able Energy: Elective |
| | Compulsory | | | |
| | Data Science: Core qualification: Elective Compulsory | | | |
| | Electrical Engineering: Core qualification: Elective Com | pulsory | | |
| | Energy and Environmental Engineering: Specialisation | Energy Engineering: Elective Compulso | ory | |
| | Energy Systems: Specialisation Energy Systems: Election | ve Compulsory | | |
| | General Engineering Science (English program, 7 seme | | - | npulsory |
| | Green Technologies: Energy, Water, Climate: Specialisa | | - | |
| | Computational Science and Engineering: Specialisation | II. Mathematics & Engineering Science | Elective Compu | ilsory |
| | Renewable Energies: Core qualification: Compulsory | | | |
| | Theoretical Mechanical Engineering: Technical Complete | | | |
| | Theoretical Mechanical Engineering: Specialisation Ene | rgy Systems: Elective Compulsory | | |

| Typ L | |
|-------------------|--|
| 51 | Lecture |
| Hrs/wk 3 | 3 |
| CP 4 | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer F | Prof. Christian Becker |
| Language | DE |
| Cycle V | 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 |
| | Internet and modeling of cleare power systems Ines |
| | • transformers |
| | synchronous machines |
| | induction machines |
| | loads and compensation |
| | grid structures and substations |
| | fundamentals of energy conversion |
| | electro-mechanical energy conversion |
| | • thermodynamics |
| | power station technology |
| | • renewable energy conversion systems |
| | steady-state network calculation |
| | network modelling load flow calculation |
| | • (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 | A. J. Schwab: "Elektroenergiesysteme", Springer, 5. Auflage, 2017 |
| F | R. Flosdorff: "Elektrische Energieverteilung" Vieweg + Teubner, 9. Auflage, 2008 |

| Course L16/1: Electrical Pow | er Systems I: Introduction to Electrical Power Systems |
|------------------------------|--|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Christian Becker |
| Language | DE |
| Cycle | WiSe |
| Content | fundamentals and current development trends in electric power engineering |
| | tasks and history of electric power systems |
| | symmetric three-phase systems |
| | fundamentals and modelling of eletric power systems |
| | • 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 occopy fundamentals |
| | 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 |

| Module M0760: Elect | onic Devices | | | | | |
|-----------------------------------|---|--------------------------|------------------------------|------------------------------|----------------|-----------------------|
| Courses | | | | | | |
| Title | | | Тур | | Hrs/wk | СР |
| Electronic Devices (L0720) | | | Lecture | | 3 | 4 |
| Electronic Devices (L0721) | | | Project- | /problem-based Learning | 2 | 2 |
| Module Responsible | | | | | | |
| Admission Requirements | None | un theory cleatrical. | uuranta in colid state mat | aviala hasiss in solid stat | | |
| Recommended Previous Knowledge | Atomic model and quante | um theory, electrical o | currents in solid state mat | eridis, dasics iri soliu-sta | te physics | |
| Kilomeuge | Successful participation of | of Physics for Enginee | rs and Materials in Electric | al Engineering or course | es with equiva | lent contents |
| Educational Objectives | After taking part success | fully, students have r | eached the following learn | ing results | | |
| Professional Competence | | | | | | |
| Knowledge | | | | | | |
| | Students are able | | | | | |
| | to represent the base | asics of semiconducto | or physics | | | |
| | | | | | | |
| | to explain the oper | rating principle of imp | oortant semiconductor dev | ices, | | |
| | to outline device classifier | haracteristics and eq | uivalent circuits as well as | to explain their derivation | on and | |
| | to discuss the limit | ation of device mode | ls. | | | |
| | | | | | | |
| | | | | | | |
| Skills | | | | | | |
| | Students are capable | | | | | |
| | to apply devices in | basic circuits. | | | | |
| | | | | | | |
| | to realize the phys | ical context and to so | lve complex problems by | oneself | | |
| | | | | | | |
| Personal Competence | | | | | | |
| Social Competence | Students are able to prep | pare and perform the | r lab experiments in team | work as well as to pres | ent and discus | ss the results in fro |
| | of audience. | | | | | |
| Autonomy | Students are capable to a | acquire knowledge ba | sed on literature in order | to prepare their experim | ents. | |
| Workload in Hours | | 110, Study Time in Le | ecture 70 | | | |
| Credit points | | rm | Description | | | |
| Course achievement | | rm ubject theoretical | | iten in Kleingruppen Wis | sen zu einem | bestimmten Then |
| | | actical work | | es in Form eines Ve | | |
| | | | Diskussion. Darüber | hinaus betreut jede (| Gruppe eine | Übungsaufgabe, d |
| | | | inhaltlich zu dem jew | eiligen Versuch gehört. | | |
| | Written exam | | | | | |
| Examination duration and | 120 min | | | | | |
| scale Assignment for the | General Engineering Scie | nce (German program | n, 7 semester): Specialisat | ion Electrical Engineerin | a. Compulson | A. |
| Following Curricula | Electrical Engineering: Co | | | | g. compuisor | 3 |
| | Engineering Science: Spe | | | | | |
| | General Engineering Scie | nce (English program | , 7 semester): Specialisati | on Electrical Engineering | g: Compulsory | |
| | Computational Science an | nd Engineering: Spec | ialisation II. Mathematics & | Engineering Science: E | lective Compu | llsory |

| 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; MOSFET: 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 versponse, 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 | Course 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 | | |

| Module M0708: Electi | rical Engineering III: Circuit Theory a | and Transients | | |
|-----------------------------|---|--|--------------------|----------------------|
| Courses | | | | |
| Fitle | | 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 | | | | |
| | | | | |
| | 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 | the Fourier ser | ies analysis of line |
| | networks driven by periodic signals. They know the | e methods for transient analysis of linea | r networks in tir | me and in frequen |
| | domain, and they are able to explain the frequency | behaviour and the synthesis of passive tw | o-terminal-circui | ts. |
| | | | | |
| | | | | |
| Skills | The students are able to calculate currents and ve | oltages in linear networks by means of | basic methods, | also when driven |
| | periodic signals. They are able to calculate transient | s in electrical circuits in time and frequen | cy domain and a | re able to explain |
| | respective transient behaviour. They are able to a | analyse and to synthesize the frequency | behaviour of p | assive two-termin |
| | circuits. | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Students work on exercise tasks in small guided of | groups. They are encouraged to present | and discuss the | eir results within t |
| , | group. | , | | |
| | 3 | | | |
| | | | | |
| Autonomy | The students are able to find out the required meth | ods for solving the given practice problem | ne Possibilities a | re given to test th |
| Autonomy | | | | |
| | knowledge during the lectures continuously by means of short-time tests. This allows them to control independently the educational objectives. They can link their gained knowledge to other courses like Electrical Engineering I and Mathematics I. | | | |
| | educational objectives. They can link their gained kr | lowledge to other courses like Electrical El | ngineering I and | Mathematics I. |
| | | | | |
| 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, l | Focus Mechatroni |
| Following Curricula | Compulsory | | | |
| | General Engineering Science (German program, 7 se | emester): Specialisation Electrical Enginee | ring: Compulsory | / |
| | Electrical Engineering: Core qualification: Compulsor | ſy | | |
| | Engineering Science: Specialisation Electrical Engine | eering: Compulsory | | |
| | General Engineering Science (English program, | 7 semester): Specialisation Mechanica | Engineering, I | Focus Mechatroni |
| | Compulsory | | | |
| | Computational Science and Engineering: Specialisat | in II. Mathematics C. Explored in a Calendar | · Elective Comp | |
| | computational science and Engineering. Specialisat | ion II. Mathematics & Engineering Science | . Liective compt | ilsory |
| | Mechatronics: Core qualification: Compulsory | Ion II. Mathematics & Engineering Science | . Elective compt | llsory |

| Course L0566: Circuit Theory | |
|------------------------------|--|
| | Lecture |
| Hrs/wk | |
| CP | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Alexander Kölpin, 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. Alexander Kölpin, Dr. Fabian Lurz |
| Language | DE |
| Cycle | WiSe |
| Content | see interlocking course |
| Literature | siehe korrespondierende Lehrveranstaltung |
| | see interlocking course |

| Courses | | | | |
|------------------------------------|---|---|--------------------|------------------------|
| Title | | Тур | Hrs/wk | СР |
| Combinatorial Structures and Algor | ithms (L1100) | Lecture | 3 | 4 |
| Combinatorial Structures and Algor | ithms (L1101) | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Anusch Taraz | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mathematics I + II | | | |
| Knowledge | Discrete Algebraic Structures | | | |
| | Graph Theory and Optimization | | | |
| | | | | |
| Educational Objectives | After taking part successfully, students have rea | ched the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students can name the basic concepts in | n Combinatorics and Algorithms. They are at | le to explain the | em using appropria |
| | examples. | | | |
| | | between these concepts. They are capable | of illustrating th | ese connections w |
| | the help of examples. | | 5 | |
| | They know proof strategies and can repro | duce them. | | |
| | | | | |
| | | | | |
| Skills | . Chudanta ann madal amhlana is Camh | | h | alle al la Aleta accor |
| | | inatorics and Algorithms with the help of t | ne concepts stu | idied in this cour |
| | Moreover, they are capable of solving the | | nto otudio din the | |
| | | urther logical connections between the conce | | |
| | For a given problem, the students can or results. | develop and execute a suitable approach, a | nd are able to c | ritically evaluate |
| | results. | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| boeiar competence | Students are able to work together in team | ms. They are capable to use mathematics as | a common langu | age. |
| | In doing so, they can communicate new of | concepts according to the needs of their coop | perating partners | . Moreover, they o |
| | design examples to check and deepen the | e understanding of their peers. | | |
| | | | | |
| | | | | |
| Autonomy | Students are capable of checking their up | nderstanding of complex concepts on their o | wn. They can so | ecify open questio |
| | precisely and know where to get help in s | | init they can be | centy open question |
| | | istence to be able to work for longer period | s in a goal-orier | ited manner on ha |
| | problems. | 5 1 | 5 | |
| | | | | |
| | | | | |
| 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 | Computer Science: Specialisation Computer and | Software Engineering: Elective Compulsory | | |
| Following Curricula | Computer Science: Specialisation Computationa | Mathematics: Elective Compulsory | | |
| | Computer Science: Specialisation II. Mathematic | s and Engineering Science: Elective Compulso | ory | |
| | Data Science: Core qualification: Elective Compu | llsory | | |
| | Computational Science and Engineering: Special | isation II. Mathematics & Engineering Science | e: Elective Comp | ulsory |
| | Technomathematics: Specialisation I. Mathemat | ics: Elective Compulsory | | |

| Course L1100: Combinatoria | Structures and Algorithms |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Anusch Taraz |
| Language | DE/EN |
| Cycle | WiSe |
| Content | Counting Structural Graph Theory Analysis of Algorithms Extremal Combinatorics Random discrete structures |
| Literature | M. Aigner: Diskrete Mathematik, Vieweg, 6. Aufl., 2006 J. Matoušek & J. Nešetřil: Diskrete Mathematik - Eine Entdeckungsreise, Springer, 2007 A. Steger: Diskrete Strukturen - Band 1: Kombinatorik, Graphentheorie, Algebra, Springer, 2. Aufl. 2007 A. Taraz: Diskrete Mathematik, Birkhäuser, 2012. |

| Course L1101: Combinatoria | ourse L1101: Combinatorial Structures and Algorithms | | |
|----------------------------|--|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 1 | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Prof. Anusch Taraz | | |
| Language | DE/EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Engineering | | | | |
|--|--|--|--------------------|---------------------|
| Module M0889: Mech | anics I (Statics) | | | |
| <u></u> | | | | |
| Courses | | | | |
| Title | | Typ Lecture | Hrs/wk 2 | СР 3 |
| Mechanics I (Statics) (L1001) Mechanics I (Statics) (L1002) | | Recitation Section (small) | 2 | 2 |
| Mechanics I (Statics) (L1002) | | Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof. Robert Seifried | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Solid school knowledge in mathematics and physics. | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached | the following learning results | | |
| Professional Competence | 51 5. | 5 5 | | |
| | The students can | | | |
| | | | | |
| | describe the axiomatic procedure used in med | chanical contexts; | | |
| | explain important steps in model design; | | | |
| | present technical knowledge in stereostatics. | | | |
| Skills | The students can | | | |
| | | | | |
| | explain the important elements of mathematic their own problems; | ical / mechanical analysis and model for | mation, and appi | y it to the context |
| | their own problems; | rahlama | | |
| | apply basic statical methods to engineering price of statical estimate the reach and boundaries of statical | | ala ta widar probl | omicoto |
| | | methods and extend them to be applicat | | em sets. |
| Personal Competence | | | | |
| Social Competence | The students can work in groups and support each o | ther to overcome difficulties. | | |
| Autonomy | Students are canable of determining their own stren | aths and weaknesses and to organize the | ir time and learn | ing based on those |
| Autonomy | Students are capable of determining their own strengths and weaknesses and to organize their time and learning based on those. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, 7 se | mester): Core qualification: Compulsory | | |
| Following Curricula | Civil- and Environmental Engineering: Core qualificat | ion: Compulsory | | |
| | Bioprocess Engineering: Core qualification: Compulse | ory | | |
| | Data Science: Specialisation Mechanics: Compulsory | | | |
| | Digital Mechanical Engineering: Core qualification: Co | ompulsory | | |
| | Electrical Engineering: Core qualification: Elective Co | | | |
| | Green Technologies: Energy, Water, Climate: Core qu | | | |
| | Computational Science and Engineering: Specialisati | | e: Elective Compu | ilsory |
| | Logistics and Mobility: Core qualification: Compulsor | | | |
| | Mechanical Engineering: Core qualification: Compuls | ory | | |
| | Mechatronics: Core qualification: Compulsory | | | |
| | Orientation Studies: Core qualification: Elective Com | pulsory | | |
| | Naval Architecture: Core qualification: Compulsory | | | |
| | Process Engineering: Core qualification: Compulsory Engineering and Management - Major in Logistics an | d Mobility: Core qualification: Compulsor | , | |
| | Engineering and management - Major in Eoglistics all | a mobility. Core qualification. compulsory | , | |

| Course L1001: Mechanics I (S | Statics) |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| 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 | |
| CP | 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 M0634: Introd | luction | into Me | edical Technology | y and System | S | | |
|-------------------------------------|---|--|-----------------------------|-----------------------|------------------------------|-----------------------|--------------------|
| Courses | | | | | | | |
| Title | | | | | Тур | Hrs/wk | СР |
| Introduction into Medical Technolog | gy and Syste | ms (L0342) | | | Lecture | 2 | 3 |
| Introduction into Medical Technolog | gy and Syste | ms (L0343) | | | Project Seminar | 2 | 2 |
| Introduction into Medical Technolog | gy and Syste | ms (L1876) | | | Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof. Alexa | ander Schla | aefer | | | | |
| Admission Requirements | None | | | | | | |
| Recommended Previous | principles of | of math (al | lgebra, analysis/calculus) | | | | |
| Knowledge | principles of | of stochas | tics | | | | |
| | principles (| of program | nming, R/Matlab | | | | |
| Educational Objectives | After takin | ig part succ | cessfully, students have r | eached the following | g learning results | | |
| Professional Competence | | | | | · • | | |
| | The stude | nts can ex | xplain principles of med | ical technology, inc | luding imaging systems, | , computer aided s | surgery, and medic |
| - | information | n systems. | They are able to give an | overview of regulat | tory affairs and standards | s in medical technol | ogy. |
| Skills | The studer | nts are able | e to evaluate systems an | d medical devices ir | n the context of clinical ap | pplications. | |
| Personal Competence | | | | | | | |
| Social Competence | The studer | nts describ | e a problem in medical te | echnology as a proje | ect, and define tasks that | are solved in a joint | effort. |
| Autonomy | The students can reflect their knowledge and document the results of their work. They can present the results in an appropriate | | | | | | |
| | manner. | | | | | | |
| Workload in Hours | Independe | Independent Study Time 110, Study Time in Lecture 70 | | | | | |
| Credit points | | | | | | | |
| Course achievement | Compulsory | Bonus | Form | Description | | | |
| | Yes | 10 % | Written elaboration | | | | |
| | Yes | 10 % | Presentation | | | | |
| Examination | Written exa | am | | | | | |
| Examination duration and | 90 minutes | s | | | | | |
| scale | | | | | | | |
| Assignment for the | General Er | ngineering | Science (German program | m, 7 semester): Spe | cialisation Biomedical En | gineering: Compuls | ory |
| Following Curricula | Computer | Science: S | pecialisation Computer a | nd Software Enginee | ering: Elective Compulsor | ſy | |
| | Computer | Science: S | pecialisation II. Mathema | tics and Engineering | g Science: Elective Comp | ulsory | |
| | Data Scien | nce: Core q | ualification: Elective Com | npulsory | | | |
| | Electrical Engineering: Core qualification: Elective Compulsory | | | | | | |
| | Engineerin | ng Science: | Specialisation Biomedica | al Engineering: Com | pulsory | | |
| | General Er | ngineering | Science (English progran | n, 7 semester): Spec | ialisation Biomedical Eng | jineering: Compulso | ry |
| | Computati | onal Scien | ce and Engineering: Spec | ialisation II. Mathem | natics & Engineering Scie | nce: Elective Comp | ulsory |
| | Biomedica | l Engineeri | ng: Specialisation Artifici | al Organs and Rege | nerative Medicine: Electiv | ve Compulsory | |
| | Biomedica | l Engineeri | ng: Specialisation Implar | its and Endoprosthe | ses: Elective Compulsory | | |
| | Biomedica | l Engineeri | ng: Specialisation Medica | al Technology and C | ontrol Theory: Elective Co | ompulsory | |
| | | 5 | | in recimerogy and e | , | | |
| | | 5 | 5 1 | 5,7 | s Administration: Elective | Compulsory | |

| Course L0342: Introduction into Medical Technology and Systems | | | |
|--|---|--|--|
| 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 | 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 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Alexander Schlaefer |
| Language | DE |
| Cycle | SoSe |
| Content | - imaging systems |
| | - computer aided surgery |
| | - medical sensor systems |
| | - medical information systems |
| | - regulatory affairs |
| | - standard in medical technology |
| | The students will work in groups to apply the methods introduced during the lecture using problem based learning. |
| Literature | Wird in der Veranstaltung bekannt gegeben. |

| Courses | | | | | |
|-----------------------------------|---|--|-------------------|--------|--|
| Title | | Тур | Hrs/wk | СР | |
| Solvers for Sparse Linear Systems | (L0583) | Lecture | 2 | 3 | |
| Solvers for Sparse Linear Systems | (L0584) | Recitation Section (small) | 2 | 3 | |
| Module Responsible | Prof. Sabine Le Borne | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | Mathematics I + II for Engineering stud Programming experience in C | lents or Analysis & Lineare Algebra I + II for Tec | hnomathematicia | ns | |
| Educational Objectives | After taking part successfully, students have | reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | Students can | | | | |
| | list classical and modern iteration mether repeat convergence statements for ite explain aspects regarding the efficient | rative methods, | | | |
| Skills | Students are able to analyse, implement, test, and compare iterative methods, analyse the convergence behaviour of iterative methods and, if applicable, compute congergence rates. | | | | |
| Personal Competence | | | | | |
| Social Competence | Students are able to | | | | |
| | work together in heterogeneously composed teams (i.e., teams from different study programs and background knowledge explain theoretical foundations and support each other with practical aspects regarding the implementation of algorithms | | | | |
| Autonomy | Students are capable | | | | |
| | to assess whether the supporting theoretical and practical excercises are better solved individually or in a team, to work on complex problems over an extended period of time, to assess their individual progess and, if necessary, to ask questions and seek help. | | | | |
| Workload in Hours | Independent Study Time 124, Study Time in I | _ecture 56 | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | | | | | |
| Examination duration and | 20 min | | | | |
| scale | | | | | |
| Assignment for the | Computer Science: Specialisation Computation | nal Mathematics: Elective Compulsory | | | |
| Following Curricula | | atics and Engineering Science: Elective Compuls | ory | | |
| - | | atics and Engineering Science: Elective Compuls | | | |
| | Data Science: Core qualification: Elective Con | npulsory | | | |
| | | cialisation II. Mathematics & Engineering Scienc | e: Elective Compu | ulsory | |
| | Technomathematics: Specialisation I. Mathem | natics: Elective Compulsory | | | |

| Course L0583: Solvers for Sparse Linear Systems | | |
|---|---|--|
| 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 | SoSe | |
| Content | Sparse systems: Orderings and storage formats, direct solvers Classical methods: basic notions, convergence Projection methods Krylov space methods Preconditioning (e.g. ILU) Multigrid methods Domain Decomposition Methods | |
| Literature | Y. Saad. Iterative methods for sparse linear systems M. Olshanskii, E. Tyrtyshnikov. Iterative methods for linear systems: theory and applications | |

| Course L0584: Solvers for Sparse Linear Systems | |
|---|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Sabine Le Borne |
| Language | EN |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| noune no//// Sellin | conductor Circuit Design | | | |
|--|--|---|---------------------------------------|-------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Semiconductor Circuit Design (L07 | 63) | Lecture | 3 | 4 |
| Semiconductor Circuit Design (L08 | 54) | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Matthias Kuhl | | | |
| Admission Requirements | None | | | |
| | Fundamentals of electrical engineering | | | |
| Knowledge | Basics of physics, especially semiconductor phys | sics | | |
| Educational Objectives | After taking part successfully, students have rea | ched the following learning results | | |
| Professional Competence Knowledge | Students are able to explain how analog c Students are able to explain the functiona Students know the fundamental digital log | lity of different MOS devices in electronic circ ircuits functions and where they are applied. lity of fundamental operational amplifiers and gic circuits and can discuss their advantages circuits and can explain their functionality an he use of bipolar transistors. | d their specificat and disadvantag | |
| Skills | • Students are able to develop different log | of different MOS devices and can define the p ic circuits and can design different types of lo al amplifiers and bipolar transistors for specifi | gic circuits. | ctronic circuits. |
| Personal Competence Social Competence | Students are able work efficiently in heter Students working together in small groups | ogeneous teams. s can solve problems and answer professiona | l questions. | |
| Autonomy | • Students are able to assess their level of l | knowledge. | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lec | ture 56 | | |
| Credit points | | | | |
| Course achievement | | | | |
| | Written exam | | | |
| Examination duration and | | | | |
| scale | 120 mm | | | |
| | General Engineering Science (German program, | 7 semester): Specialisation Electrical Enginee | ering: Compulsor | v |
| - | General Engineering Science (German program, General Engineering Science (German program) | | a , | |
| j | Compulsory | ,, | 5 5, | |
| | Data Science: Core qualification: Elective Compu | Ilsory | | |
| | Electrical Engineering: Core qualification: Compu | | | |
| | Engineering Science: Specialisation Electrical En | gineering: Compulsory | | |
| | Engineering Science: Specialisation Mechatronic | s: Compulsory | | |
| | General Engineering Science (English program, 7 | 7 semester): Specialisation Electrical Engineer | ring: Compulsory | |
| | General Engineering Science (English progra | m, 7 semester): Specialisation Mechanica | l Engineering, | Focus Mechatroni |
| | Compulsory | | | |
| | General Engineering Science (English program, 7 | 7 semester): Specialisation Mechatronics: Con | npulsory | |
| | Computational Science and Engineering: Special | isation II. Mathematics & Engineering Science | e: Elective Comp | llsory |
| | Mechanical Engineering: Specialisation Mechatro | onics: Compulsory | | |
| | Mechatronics: Core qualification: Compulsory | | | |
| | Technomathematics: Specialisation III. Engineeri | ng Science: Elective Compulsory | | |

| Course L0763: Semiconductor Circuit Design | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| CP | 4 | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | |
| Lecturer | Prof. Matthias Kuhl | |
| Language | DE | |
| 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 |

| Module M1269: Lab C | Cyber-Physical Systems |
|-----------------------------------|--|
| Courses | |
| Title | Typ Hrs/wk CP |
| Lab Cyber-Physical Systems (L1740 | 0) Project-/problem-based Learning 4 6 |
| Module Responsible | Prof. Heiko Falk |
| Admission Requirements | None |
| Recommended Previous | Module "Embedded Systems" |
| Knowledge | |
| Educational Objectives | After taking part successfully, students have reached the following learning results |
| Professional Competence | |
| | Cyber-Physical Systems (CPS) are tightly integrated with their surrounding environment, via sensors, A/D and D/A converters, a actors. Due to their particular application areas, highly specialized sensors, processors and actors are common. Accordingly, the is a large variety of different specification approaches for CPS - in contrast to classical software engineering approaches. Based on practical experiments using robot kits and computers, the basics of specification and modelling of CPS are taught. T lab introduces into the area (basic notions, characteristical properties) and their specification techniques (models of computation hierarchical automata, data flow models, petri nets, imperative approaches). Since CPS frequently perform control tasks, the la experiments will base on simple control applications. The experiments will use state-of-the-art industrial specification to (MATLAB/Simulink, LabVIEW, NXC) in order to model cyber-physical models that interact with the environment via sensors a actors. After successful attendance of the lab, students are able to develop simple CPS. They understand the interdependencies betwee CPS and its surrounding processes which stem from the fact that a CPS interacts with the environment via sensors, A/D converter digital processors, D/A converters and actors. The lab enables students to compare modelling approaches, to evaluate the advantages and limitations, and to decide which technique to use for a concrete task. They will be able to apply these technique |
| Personal Competence | |
| Social Competence | Students are able to solve similar problems alone or in a group and to present the results accordingly. |
| Autonomy | Students are able to acquire new knowledge from specific literature and to associate this knowledge with other classes. |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Credit points | 6 |
| Course achievement | None |
| Examination | Written elaboration |
| Examination duration and | Execution and documentation of all lab experiments |
| scale | |
| Assignment for the | General Engineering Science (German program, 7 semester): Specialisation Computer Science: Elective Compulsory |
| Following Curricula | |
| | Computer Science: Specialisation Computer and Software Engineering: Elective Compulsory |
| | General Engineering Science (English program, 7 semester): Specialisation Computer Science: Elective Compulsory |
| | Computational Science and Engineering: Specialisation II. Mathematics & Engineering Science: Elective Compulsory |
| | Mechatronics: Specialisation Intelligent Systems and Robotics: Elective Compulsory |
| | Mechatronics: Specialisation System Design: 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 |

| Engineering" | | | | |
|---|---|---|--------------------|-----------------------|
| Module M0854: Math | ematics IV | | | |
| | | | | |
| Courses | | | | |
| Title Differential Equations 2 (Partial Dif Differential Equations 2 (Partial Dif | | Typ Lecture Recitation Section (small) | Hrs/wk 2 1 | CP 1 1 |
| Differential Equations 2 (Partial Dif Complex Functions (L1038) | ferential Equations) (L1045) | Recitation Section (large) Lecture | 1 | 1 |
| Complex Functions (L1041) | | Recitation Section (small) | 1 | 1 |
| Complex Functions (L1042) | | Recitation Section (large) | 1 | 1 |
| Module Responsible | | | | |
| Admission Requirements | | | | |
| Recommended Previous Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the for | llowing learning results | | |
| Professional Competence | | | | |
| Knowledge Skills | Students can name the basic concepts in Mathematic Students can discuss logical connections between the help of examples. They know proof strategies and can reproduce them. Students can model problems in Mathematics IV with the strategies IV with the strategies | hese concepts. They are capable | of illustrating th | ese connections with |
| | capable of solving them by applying established met Students are able to discover and verify further logic For a given problem, the students can develop and results. | al connections between the conce | | |
| Personal Competence Social Competence | Students are able to work together in teams. They are capable to use mathematics as a common language. In doing so, they can communicate new concepts according to the needs of their cooperating partners. Moreover, they can design examples to check and deepen the understanding of their peers. | | | |
| Autonomy | Students are capable of checking their understandir precisely and know where to get help in solving them Students have developed sufficient persistence to b problems. | ı. | | |
| Workload in Hours | Independent Study Time 68, Study Time in Lecture 112 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| | 60 min (Complex Functions) + 60 min (Differential Equation | ns 2) | | |
| scale Assignment for the | General Engineering Science (German program, 7 semester | r): Specialisation Electrical Engine | erina: Compulson | V. |
| | General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 sem | | 5 | |
| | Compulsory General Engineering Science (German program, 7 semester General Engineering Science (German program, 7 semester Engineering: Elective Compulsory Computer Science: Specialisation Computational Mathemat | r): Specialisation Mechanical Engir | 1 | neoretical Mechanical |
| | Electrical Engineering: Core qualification: Compulsory | | | |
| | General Engineering Science (English program, 7 semester) | | | |
| | General Engineering Science (English program, 7 sem Compulsory | ester). Specialisation Mechanica | ii Engineering, I | ocus Mechatronics: |
| | | | | |
| | General Engineering Science (English program, 7 semester | r): Specialisation Mechanical Engin | neering, Focus Th | eoretical Mechanical |
| | Engineering: Compulsory | | - | |
| | | lathematics & Engineering Science | - | |
| | Engineering: Compulsory Computational Science and Engineering: Specialisation II. M Mechanical Engineering: Specialisation Mechatronics: Comp Mechanical Engineering: Specialisation Theoretical Mechani | lathematics & Engineering Science oulsory | e: Elective Compu | |
| | Engineering: Compulsory Computational Science and Engineering: Specialisation II. M Mechanical Engineering: Specialisation Mechatronics: Comp | lathematics & Engineering Science oulsory | e: Elective Compu | |

| Course L1043: Differential E | 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 |
| | 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 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 Functions | |
|---|--|
| Recitation Section (small) | |
| 1 | |
| 1 | |
| Independent Study Time 16, Study Time in Lecture 14 | |
| Dozenten des Fachbereiches Mathematik der UHH | |
| DE | |
| SoSe | |
| See interlocking course | |
| 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 |
| Theoretical Electrical Engineering I | : Time-Independent Fields (L0180) | Lecture | 3 | 5 |
| Theoretical Electrical Engineering I | | Recitation Section (small) | 2 | 1 |
| Module Responsible | Prof. Christian Schuster | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic principles of electrical engineering and adv | anced mathematics | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have read | ched the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students can explain the fundamental formulas, | relations, and methods of the theory of tim | e-independent el | ectromagnetic fiel |
| | They can explicate the principal behavior of el | | | |
| | sources. They can describe the properties of co | | | |
| | fields. The students are aware of applications fo | r the theory of time-independent electroma | gnetic fields and | are able to explic |
| | these. | | | |
| | | | | |
| Skille | Students can apply Maxwell's Equations in | integral notation in order to solve his | ubly symmetrical | timo indonondo |
| SKIIIS | | | | |
| | 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 are | | | |
| | analyze these quantitatively. They can deduce n | | | |
| | electrical flow fields (capacitances, inductances, | 5 1 | | 5 |
| | | | | |
| Demonstration of the second seco | | | | |
| Personal Competence | Students are able to work tegether on subject re | lated tacks in small groups. They are able to | a procept their re- | sulta offectively (e |
| Social Competence | Students are able to work together on subject re during exercise sessions). | nated tasks in small groups. They are able to | o present their re | suits effectively (e |
| | during exercise sessions). | | | |
| Autonomy | Students are capable to gather necessary inform | ation from provided references and relate th | is information to | the lecture. They a |
| , | able to continually reflect their knowledge by me | | | |
| | lectures and exercises that are related to the exa | | | |
| | learning process. They are able to draw connect | tions between their knowledge obtained in | this lecture and | the content of ot |
| | lectures (e.g. Electrical Engineering I, Linear Alge | bra, and Analysis). | | |
| | | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lect | ure 70 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90-150 minutes | | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, | 7 semester): Specialisation Electrical Engine | ering: Compulsory | / |
| Following Curricula | Electrical Engineering: Core qualification: Compu | lsory | | |
| | Computational Science and Engineering: Speciali | sation II. Mathematics & Engineering Science | e: Elective Compu | Ilsory |
| | Technomathematics: Specialisation III. Engineering | | | |

| Course L0180: Theoretical El | ectrical Engineering I: Time-Independent Fields |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 5 |
| Workload in Hours | Independent Study Time 108, Study Time in Lecture 42 |
| Lecturer | Prof. Christian Schuster |
| Language | DE |
| Cycle | SoSe |
| 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 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 L0181: Theoretical El | urse 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 | |

Specialization III. Subject Specific Focus

| ourses | | | |
|--------------------------------|---|------------|----|
| tle | Тур | Hrs/wk | СР |
| Module Responsible | Prof. Volker Turau | | |
| Admission Requirements | None | | |
| Recommended Previous | | | |
| Knowledge | | | |
| Educational Objectives | After taking part successfully, students have reached the following learning results | | |
| Professional Competence | | | |
| Knowledge | | | |
| Skills | | | |
| Personal Competence | | | |
| Social Competence | | | |
| Autonomy | | | |
| Workload in Hours | Depends on choice of courses | | |
| Credit points | 12 | | |
| Assignment for the | Computational Science and Engineering: Specialisation III. Subject Specific Focus: Elective | Compulsory | |
| Following Curricula | | | |

| Thesis | | | | | |
|--|---|--|--|--|--|
| Module M-001: Bachelor Thesis | | | | | |
| Courses | | | | | |
| Title | Typ Hrs/wk CP | | | | |
| Module Responsible | | | | | |
| Admission Requirements | According to Constal Regulations 521 (1): | | | | |
| | 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 Skills | 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. 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 | | | | |
| Personal Competence Social Competence | | | | | |
| 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 | 12 | | | | |
| Course achievement | None | | | | |
| Examination | | | | | |
| Examination duration and scale | According to General Regulations | | | | |
| Assignment for the | General Engineering Science (German program): Thesis: Compulsory General Engineering Science (German program, 7 semester): Thesis: Compulsory Civil- and Environmental Engineering: Thesis: Compulsory 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, 7 semester): Thesis: Compulsory Green Technologies: Energy, Water, Climate: Thesis: Compulsory Computational Science and Engineering: Thesis: Compulsory Logistics and Mobility: Thesis: Compulsory Mechanical Engineering: Thesis: Compulsory Mechanical Engineering: 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: Thesis: Compulsory | | | | |