

Module Manual

Master of Science (M.Sc.)

Civil Engineering Dual study program

Cohort: Winter Term 2024 Updated: 5th August 2024

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Program description

Content

Civil engineering deals with the erection of buildings of all kind, in particular of structures like bridges and tunnels, structures in hydraulic engineering, water supply, waste and waste water disposal, harbour construction, streets, hall construction, as well as industrial and housing construction, including refurbishment. The master program civil engineering gives graduates the qualification to process difficult projects in the construction practice, including the necessary competences in business and management. Buildings arise by the cooperation of owners, planning offices, contractors, environment, politicians and society. Civil engineering is located in the field between technical and economic constraint, political will and legal conditions. The master program prepares for that. The master program also opens the way to doctoral studies and successful research activities, assuming a sufficient diploma.

The master program civil engineering is associated with the bachelor program "Bau- und Umweltingenieurwesen" and "Allgemeine Ingenieurwissenschaften Vertiefung Bauingenieurwesen" of the University of Technology Hamburg in the sense of a consecutive course of studies. Possible entries from other bachelor programs are based on a catalog of requirements, described in the document "Specific Requirements for the Master Program Civil Engineering".

In addition to the foundational curriculum taught at TUHH, seminars on developing personal skills are integrated into the dual study programme, in the context of transfer between theory and practice. These seminars correspond to the modern professional requirements expected of an engineer, as well as promoting the link between the two places of learning.

The intensive dual courses at TUHH integrating practical experience consist of an academic-oriented and a practice-oriented element, which are completed at two places of learning. The academic-oriented element comprises study at TUHH. The practice-oriented element is coordinated with the study programme in terms of content and time, and consists of practical modules and phases spent in an affiliate company during periods when there are no lectures.

Career prospects

The graduates of the master program civil engineering are prepared for a leading professional activity in planning offices, at building contractors, building authorities, owners of major immovables and infrastructure, producers of building products, material testing institutions and in research facilities. It aims at activities in extensive and difficult projects, or in research and development. In Germany a great demand exists at this time for civil engineers in particular with good knowledge in structural engineering. The master program is based on this demand.

In addition, students acquire basic professional and personal skills as part of the dual study programme that enable them to enter professional practice at an early stage and to go on to further study. Students also gain practical work experience through the integrated practical modules. Graduates of the dual course have broad foundational knowledge, fundamental skills for academic work and relevant personal competences.

Learning target

The graduates of the master program civil engineering gain the specialist knowledge and the methods, to plan and erect new buildings, in particular concrete structures, steel structures, structures in water engineering, in foundation engineering, in water supply, waste and waste water disposal, including refurbishment of existing structures. This incorporates the realization of necessary preliminary investigations, the design of structural elements, the development of all necessary proofs and the project management.

The graduates of the master program are able to transfer the acquired knowledge in engineering, mathematics and natural sciences to practical applications and to analyze and solve problems on a scientific basis, even if these are unusual or incompletely defined and comprise complex specifications. The graduates are able to successfully work on research projects in the field of civil engineering. Therefore a comprehensive understanding of the underlying processes and the ability to model and calculate such processes, e.g. with Finite Elements Methods, are necessary.

The graduates for this purpose gain the skills to experimentally determine the necessary properties of soil, materials and components and to deal with construction-specific program systems to calculate mechanical behavior, the hydraulics of systems as well as other physical-chemical processes. They are enabled to work on problems of civil engineering and related disciplines on one's own. They are able to use methods needed for the solution of technical problems and planning procedures. They are able to use new findings in a critical way and to improve methods and new developments.

The graduates can communicate on advanced contents and problems of civil engineering with specialists and the laity. They are able to present their methods and the results of their work in writing and verbally in a comprehensive way. The graduates in addition learn to work on problems in a team in a purposeful way, and to document and present their methods and results understandably with up-to-date presentation methods to other persons. They learn to take the leadership for parts of a project or the whole. They are able to familiarize themselves with a topic and to select suitable methods to solve questions and problems. They are able to acquire the necessary information about a topic on one's own and to put the new information in the context of their knowledge.

The graduates are further qualified to develop concept designs for difficult projects in structural engineering, foundation engineering, bridge design and hydraulic engineering and to plan such constructions under consideration of the available information and restrictions. They can:

- successfully cooperate with expert und inexpert partners from the public administration, the economy and science,
- autonomously define, plan and conduct scientific tasks and to theoretically or experimentally investigate constructions, ground, materials, infrastructure as well as management duties,
- responsibly evaluate and consider the interests of building partners, people concerned and the society as a whole.

By continually switching places of learnings throughout the dual study programme, it is possible for theory and practice to be interlinked. Students reflect theoretically on their individual professional practical experience, and apply the results of their reflection to new forms of practice. They also test theoretical elements of the course in a practical setting, and use their findings as a stimulus for theoretical debate.

Program structure

The master program consists of modules which 6 credit points according to ECTS (CP) except for the master thesis. It is divided into a "Core Qualification", into the five alternative specializations "Coastal Engineering", "Geotechnical Engineering", "Structural Engineering", "Water and Traffic" and "Computational Engineering", as well as the master thesis. The core qualification covers 54 CP, each specialization covers 66 CP and the master thesis covers 30 CP. The program covers 150 CP in 2 years with 4 terms in total.

The core qualification contains a module "Finite Elements Methods" as well as a module "Sustainability and Risk Management" in the 1st term. In addition an open module during the 1st, 2nd or 3rd term from the field "Business and Management" as well as a module from the "Non-technical Courses for Master" are incorporated. The lectures of these open modules are selected from catalogs that are independend from the specific master program.

Each specialization covers 42 CP in the compulsory modules, that are indispensable for the specialization, and 24 CP in the mandatory electives. They contain also an open module and a project work with 6 CP in each case. The compulsory modules excepting the project work are located in the 1st and 2nd term.

The 4th term covers the master thesis. In addition lectures of the open module of the specialization can still be attended in the 4th term. The students must select a specialization and they have the choice to elect different options in the field of "Business and Management", in the field of the "Non-technical Courses for Master" and in the mandatory electives of the specialization.

A term abroad is possible. In particular the 3rd semester is used by the students to go abroad, because in the 3rd term there are no compulsory modules, but only mandatory electives.

The structural model of the dual study programme follows a module-differentiating approach. Given the practice-oriented element, the curriculum of the dual study programme is different compared to a standard Bachelor's course. Five practical modules are completed at the dual students' partner company as part of corresponding practical terms during lecture-free periods.

Core Qualification

| Module M0523: Busin | ess & Management |
|--------------------------------|---|
| March Jac Process of the | |
| Module Responsible | |
| Admission Requirements | |
| Recommended Previous | None |
| Knowledge | |
| Educational Objectives | After taking part successfully, students have reached the following learning results |
| Professional Competence | |
| Knowledge | Students are able to find their way around selected special areas of management within the scope of business management. Students are able to explain basic theories, categories, and models in selected special areas of business management. Students are able to interrelate technical and management knowledge. |
| Skills | Students are able to apply basic methods in selected areas of business management. Students are able to explain and give reasons for decision proposals on practical issues in areas of business management. |
| Personal Competence | |
| Social Competence | • Students are able to communicate in small interdisciplinary groups and to jointly develop solutions for complex problems |
| Autonomy | • Students are capable of acquiring necessary knowledge independently by means of research and preparation of material. |
| | |
| Workload in Hours | Depends on choice of courses |
| Credit points | 6 |
| • | |

Courses

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

| Module Responsible | Dr. Henning Haschke | | |
|--------------------------|--|--|--|
| Admission Requirements | • | | |
| Recommended Previous | NUIR | | |
| Knowledge | Successful completion of practical modules as part of the dual Bachelor's course | | |
| | Module "interlinking theory and practice as part of the dual Master's course" | | |
| Educational Objectives | After taking part successfully, students have reached the following learning results | | |
| Professional Competence | | | |
| Knowledge | Dual students | | |
| | can describe and classify selected classic and current theories, concepts and methods | | |
| | related to project management and | | |
| | change and transformation management | | |
| | and apply them to specific situations, processes and plans in a personal, professional context. | | |
| Skills | Dual students | | |
| | anticipate typical difficulties, positive and negative effects, as well as success and failure factors in the engine sector, evaluate them and consider promising strategies and courses of action. develop specialised technical and conceptual skills to solve complex tasks and problems in their professional fier activity/work. | | |
| Personal Competence | | | |
| Social Competence | Dual students | | |
| | can responsibly lead interdisciplinary teams within the framework of complex tasks and problems. engage in sector-specific and cross-sectoral discussions with experts, stakeholders and staff, representing approaches, points of view and work results. | | |
| Autonomy | Dual students | | |
| | define, reflect and evaluate goals and measures for complex application-oriented projects and change processes. | | |
| | shape their professional area of responsibility independently and sustainably. | | |
| | take responsibility for their actions and for the results of their work. | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 | | |
| Credit points | 6 | | |
| Course achievement | None | | |
| Examination | Written elaboration | | |
| Examination duration and | Studienbegleitende und semesterübergreifende Dokumentation: Die Leistungspunkte für das Modul werden durch die Anfertig | | |
| scale | | | |

| • | Course L2890: Responsible Project Management in Engineering (for Dual Study Program) | |
|-------------------|---|--|
| Тур | Seminar | |
| Hrs/wk | 3 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | |
| Lecturer | Dr. Henning Haschke, Heiko Sieben | |
| Language | DE | |
| Cycle | WiSe/SoSe | |
| Content | Content • Theories and methods of project management • Innovation management • Agile project management • Fundamentals of classic and agile methods • Hybrid use of classic and agile methods • Roles, perspectives and stakeholders throughout the project • Initiating and coordinating complex engineering projects • Principles of moderation, team management, team leadership, conflict management • Communication structures: in-house, cross-company • Public information policy • Promoting commitment and empowerment • Sharing experience with specialists and managers from the engineering sector • Documenting and reflecting on learning experiences | |
| Literature | Seminarapparat | |

| Course L2891: Responsible C | hange and Transformation Management in Engineering (for Dual Study Program) | | |
|-----------------------------|---|--|--|
| Тур | Seminar | | |
| Hrs/wk | 3 | | |
| CP | 3 | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | |
| Lecturer | Dr. Henning Haschke, Heiko Sieben | | |
| Language | DE | | |
| Cycle | WiSe/SoSe | | |
| Content | Cycle WiSe/SoSe Content Basic concepts, opportunities and limits of organisational change Models and methods of organisational design and development Strategic orientation and change, and their short-, medium- and long-term consequences for individuals, organisations and society as a whole Roles, perspectives and stakeholders in change processes Initiating and coordinating change measures in engineering Phase models of organisational change (Lewin, Kotter, etc.) Change-oriented information policy and dealing with resistance and uncertainty Promoting commitment and empowerment Successfully handling change and transformation: personally, as an employee, as a manager (personal, professional organisational) Company-level and globally (systemic) Sharing experience with specialists and managers from the engineering sector Documenting and reflecting on learning experiences | | |
| Literature | Seminarapparat | | |

| Courses | | | | |
|-------------------------------------|--|---------------------------------------|------------------------------|----------------------|
| Title | | Тур | Hrs/wk | СР |
| Practical term 1 (dual study progra | n, Master's degree) (L2887) | | 0 | 10 |
| Module Responsible | Dr. Henning Haschke | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Successful completion of a compatible dual B.S | c at TIL Hamburg or comparable | e practical work experier | |
| Knowledge | in the area of interlinking theory and practice | | proceed work experien | ice and competent |
| | Course D from the module on interlinking theory | ry and practice as part of the dua | al Master's course | |
| Educational Objectives | After taking part successfully, students have reached | the following learning results | | |
| Professional Competence | , the taking part succession, statents have reacted | the following learning results | | |
| | Dual students | | | |
| | combine their knowledge of facts, principle | es, theories and methods gained | d from previous study c | ontent with acqui |
| | practical knowledge - in particular their knowle | - | | • |
| | of activity in engineering. | | | |
| | • have a critical understanding of the practica | l applications of their engineerin | g subject. | |
| Skills | Dual students | | | |
| | apply technical theoretical knowledge to | complex interdisciplinant probl | ome within the compar | w and evaluate |
| | associated work processes and results, taking i | | | iy, and evaluate |
| | implement the university's application record | | | |
| | develop solutions as well as procedures and | | | bility. |
| Personal Competence | | | | |
| Social Competence | Dual students | | | |
| | | · · · · · · · · · · · · · · · · · · · | and the second second second | |
| | work responsibly in project teams within the represent complex engineering viewpoints | | | |
| | external stakeholders. | , lacts, problems and solution | approaches in discussio | |
| 4 | Dual stude sta | | | |
| Autonomy | Dual students | | | |
| | define goals for their own learning and work | | | |
| | reflect on learning and work processes in the | 1 , | liastica for work of a | |
| | reflect on the relevance of subject mode implement the university's application recom | | | ÷ |
| | between theory and practice. | | chancinges to positively | |
| Werkland in Hours | Independent Study Time 200 Study Time in Lesture (| | | |
| Credit points | Independent Study Time 300, Study Time in Lecture (| J | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | Documentation accompanying studies and across ser | nesters: Module credit points are | e earned by completing | a digital learning a |
| scale | development report (e-portfolio). This documents an | d reflects individual learning ex | periences and skills dev | elopment relating |
| | interlinking theory and practice, as well as profes | • | | rovides proof to |
| | dual@TUHH Coordination Office that the dual student | has completed the practical pha | ise. | |
| Assignment for the | Civil Engineering: Core Qualification: Compulsory | n/ | | |
| Following Curricula | Bioprocess Engineering: Core Qualification: Compulso Chemical and Bioprocess Engineering: Core Qualificat | - | | |
| | Computer Science: Core Qualification: Compulsory | | | |
| | Data Science: Core Qualification: Compulsory | | | |
| | Electrical Engineering: Core Qualification: Compulsory | / | | |
| | Energy Systems: Core Qualification: Compulsory | | | |
| | Environmental Engineering: Core Qualification: Comp | | | |
| | Aircraft Systems Engineering: Core Qualification: Com Computer Science in Engineering: Core Qualification: | | | |
| | Information and Communication Systems: Core Qualif | | | |
| | International Management and Engineering: Core Qua | | | |
| | Logistics, Infrastructure and Mobility: Core Qualification | on: Compulsory | | |
| | Aeronautics: Core Qualification: Compulsory | | | |
| | Materials Science and Engineering: Core Qualification | : Compulsory | | |
| | Materials Science: Core Qualification: Compulsory | fication, Compulson | | |
| | Mechanical Engineering and Management: Core Quali Mechatronics: Core Qualification: Compulsory | ilcation: Compulsory | | |
| | Biomedical Engineering: Core Qualification: Compulsory | rv | | |
| | | | | |
| | Microelectronics and Microsystems: Core Qualification | 1: Compulsory | | |
| | Microelectronics and Microsystems: Core Qualificatior Product Development, Materials and Production: Core | | | |

Module Manual M.Sc. "Civil Engineering"

| Naval Architecture and Ocean Engineering: Core Qualification: Compulsory |
|--|
| Theoretical Mechanical Engineering: Core Qualification: Compulsory |
| Process Engineering: Core Qualification: Compulsory |
| Water and Environmental Engineering: Core Qualification: Compulsory |

| Course L2887: Practical term | 1 (dual study program, Master's degree) | | |
|------------------------------|--|--|--|
| Тур | | | |
| Hrs/wk |) | | |
| CP | 10 | | |
| Workload in Hours | Independent Study Time 300, Study Time in Lecture 0 | | |
| Lecturer | Dr. Henning Haschke | | |
| Language | DE | | |
| Cycle | WiSe/SoSe | | |
| Content | Company onboarding process | | |
| | Assigning a professional field of activity as an engineer (B.Sc.) and associated fields of work Establishing responsibilities and authorisation of the dual student within the company as an engineer (B.Sc.) Working independently in a team and on selected projects - across departments and, if applicable, across companies Scheduling the current practical module with a clear correlation to work structures Scheduling the examination phase/subsequent study semester Operational knowledge and skills Company-specific: Responsibility as an engineer (B.Sc.) in their own area of work, coordinating team and project work, dealing with complex contexts and unsolved problems, developing and implementing innovative solutions Subject specialisation (corresponding to the chosen course [M.Sc.]) in the field of activity Systemic skills Implementing the university's application recommendations (theory-practice transfer) in corresponding work and task areas across the company | | |
| | Sharing/reflecting on learning | | |
| | Creating an e-portfolio Importance of course contents (M.Sc.) when working as an engineer Importance of development and innovation when working as an engineer | | |
| Literature | Studierendenhandbuch Betriebliche Dokumente Hochschulseitige Handlungsempfehlungen zum Theorie-Praxis-Transfer | | |

| Courses | | | | |
|------------------------------------|---|--|-------------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Circular Economy (L3264) | | Seminar | 2 | 3 |
| Environment and Sustainability (L0 | 1319) | Lecture | 2 | 3 |
| Module Responsible | Prof. Kerstin Kuchta | | | |
| Admission Requirements | None | | | |
| Recommended Previous | none | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students | have reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Economy as well as environmental and | | ield of safety and risk | assessment, Circu |
| | basics in safety and reliability of | | | |
| | risk assessment and reliability and Circularity of restantial | nalysis methods | | |
| | Circularity of material | material flows | | |
| | Identification and evaluation of material flows | | | |
| | energy production and supplysustainable product design | | | |
| | subtainable product design | | | |
| Skills | | ary system-oriented methods for Circularity ar and costs for processes and select economicall | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | | ubject area from given sources and transform esearch-oriented duties in for risk management ural impact. | | |
| Workload in Hours | Independent Study Time 124, Study Tir | me in Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | Elaboration and presentation (45 minut | tes in groups) | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Core Qualification: Co | ompulsory | | |
| - | | n C - Bioeconomic Process Engineering, Fo | cus Management and | Controlling: Elect |
| - | Compulsory | | - | - |
| | Chemical and Bioprocess Engineering: | Specialisation General Process Engineering: Ele | ctive Compulsory | |
| | Chemical and Bioprocess Engineering: | Specialisation Bioprocess Engineering: Elective | Compulsory | |
| | Chemical and Bioprocess Engineering: | Specialisation Chemical Process Engineering: El | lective Compulsory | |
| | Chemical and Bioprocess Engineering: | Specialisation Chemical and Bio process Engine | ering: Elective Compuls | ory |
| | | ion Energy and Resources: Elective Compulsory | • | - |
| | | oduction: Specialisation Product Development: | | |
| | 1 | | . , | |
| | Product Development, Materials and Pro | oduction: Specialisation Production: Elective Co | mpulsory | |
| | | oduction: Specialisation Production: Elective Co oduction: Specialisation Materials: Elective Com | | |

| Course L3264: Circular Econo | ourse L3264: Circular Economy | |
|------------------------------|---|--|
| Тур | Seminar | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Dr. Marco Ritzkowski | |
| Language | EN | |
| Cycle | WiSe | |
| Content | | |
| Literature | | |

| Course L0319: Environment | and Sustainability |
|---------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Kerstin Kuchta |
| Language | EN |
| Cycle | WiSe |
| Content | This course presents actual methodologies and examples of environmental relevant, sustainable technologies, concepts and strategies in the field of energy supply, product design, water supply, waste water treatment or mobility. The following list shows examples: Production and use of biochar Energy production with algae Environmentally friendly product design Clean development mechanisms Democracy and energy Alternative mobility |
| Literature | Wird in der Veranstaltung bekannt gegeben. |

| Module M2024: Finite | elements | | | |
|-----------------------------|---|--|----------------------|---------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Finite elements (L3279) | | Lecture | 3 | 3 |
| Finite elements (L3280) | | Recitation Section (large) | 2 | 3 |
| Module Responsible | Prof. Bastian Oesterle | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Mechanics I/II, Mathematics I/II, Differential Equa | tions I, Structural Analysis I, Structural Analy | sis II, Structural A | Analysis III |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have rea | ched the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After successful completion of this module, stu | dents can express theoretical, methodologi | cal and practical | aspects of the fini |
| | element method. | | | |
| Skills | After successfully completing this module, students are able to derive, implement and appropriately apply finite element | | | |
| 51.005 | formulations. | | | apply mile cleme |
| Personal Competence | | | | |
| Social Competence | Students can participate in subject-specific and | interdisciplinary discussions, defend their or | wn work results i | n front of others a |
| | promote the scientific development of colleague | s. Furthermore, they can give and accept pro | ofessional constru | ictive criticism. |
| | | | | |
| Autonomy | Autonomy Students are able to gain knowledge of the subject area from given and other sources and apply it to new problems. Further | | oblems. Furthermor | |
| | they are able to structure the solution process for | or problems in the area of the finite element i | nethod. | |
| Workload in Hours | Independent Study Time 110, Study Time in Lec | ture 70 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Core Qualification: Compulsory | / | | |
| Following Curricula | | | | |

| Course L3279: Finite elemen | Course L3279: Finite elements | | |
|-----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 3 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | |
| Lecturer | Prof. Bastian Oesterle | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Direct stiffness method, variational formulation of finite elements, requirements for the approaches, convergence conditions, isoparametric concept finite elements for trusses, beams, disks and plates, locking and alternative FE formulations, basics of model building, mathematical and numerical model, assessment and interpretation of calculation results, Singularities, influence of approximation errors, interactions between mathematical and numerical models | | |
| Literature | Vorlesungsskript | | |

| Course L3280: Finite elemen | ts |
|-----------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Bastian Oesterle |
| Language | DE |
| Cycle | WiSe |
| Content | Direct stiffness method, variational formulation of finite elements, requirements for the approaches, convergence conditions, isoparametric concept finite elements for trusses, beams, disks and plates, locking and alternative FE formulations, basics of model building, mathematical and numerical model, assessment and interpretation of calculation results, Singularities, influence of approximation errors, interactions between mathematical and numerical models |
| Literature | Vorlesungsskript |

| Courses | | | | |
|-------------------------------------|--|---|--|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Practical term 2 (dual study progra | m, Master's degree) (L2888) | | 0 | 10 |
| Module Responsible | Dr. Henning Haschke | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Successful completion of practical module | 1 as part of the dual Master's course | | |
| Knowledge | course D from the module on interlinking t | | | |
| Educational Objectives | After taking part successfully, students have reac | hed the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Dual students | | | |
| | combine their knowledge of facts, prin practical knowledge - in particular their kn of activity in engineering. have a critical understanding of the prace | owledge of practical professional pro | ocedures and approaches | |
| Skills | Dual students | | | |
| | apply technical theoretical knowledge associated work processes and results, tak implement the university's application r develop (new) solutions as well as pr including in the case of frequently changin | ing into account different possible co ecommendations with regard to their ocedures and approaches in their | ourses of action. | |
| Personal Competence | | | | |
| Social Competence | Dual students | | | |
| | work responsibly in cross-departmenta their team. | I and interdisciplinary project teams | s and proactively deal v | vith problems wit |
| | represent complex engineering viewpo external stakeholders and develop these fu | | approaches in discussion | ns with internal a |
| Autonomy | / Dual students | | | |
| | define goals for their own learning and w reflect on learning and work processes i reflect on the relevance of subject r implement the university's application reduction the between theory and practice. | n their area of responsibility. nodules specialisations and special | | - |
| Workload in Hours | Independent Study Time 300, Study Time in Lecto | ure 0 | | |
| Credit points | 10 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and scale | Documentation accompanying studies and across development report (e-portfolio). This document interlinking theory and practice, as well as p dual@TUHH Coordination Office that the dual stud | s and reflects individual learning ex rofessional practice. In addition, th | periences and skills devi ne partner company pr | elopment relating |
| Assignment for the | Civil Engineering: Core Qualification: Compulsory | | | |
| Following Curricula | Bioprocess Engineering: Core Qualification: Comp | oulsory | | |
| | Chemical and Bioprocess Engineering: Core Quali | | | |
| | Computer Science: Core Qualification: Compulsor | У | | |
| | Data Science: Core Qualification: Compulsory Electrical Engineering: Core Qualification: Compu | loop | | |
| | Energy Systems: Core Qualification: Compulsory | ISOI ý | | |
| | Environmental Engineering: Core Qualification: Co | ompulsory | | |
| | Aircraft Systems Engineering: Core Qualification: | Compulsory | | |
| | Computer Science in Engineering: Core Qualificat | ion: Compulsory | | |
| | Information and Communication Systems: Core Q | | | |
| | International Management and Engineering: Core | | | |
| | Logistics, Infrastructure and Mobility: Core Qualifi Aeronautics: Core Qualification: Compulsory | санон: сотривогу | | |
| | Materials Science and Engineering: Core Qualifica | ation: Compulsory | | |
| | Materials Science: Core Qualification: Compulsory | | | |
| | Mechanical Engineering and Management: Core C | Qualification: Compulsory | | |
| | Mechatronics: Core Qualification: Compulsory | | | |
| | Biomedical Engineering: Core Qualification: Comp | | | |
| | Microelectronics and Microsystems: Core Qualification Product Development, Materials and Production: | | | |
| | Product Development, Materials and Production: | Core Quanneacion. Compuisory | | |

Module Manual M.Sc. "Civil Engineering"

| Renewable Energies: Core Qualification: Compulsory |
|--|
| Naval Architecture and Ocean Engineering: Core Qualification: Compulsory |
| Theoretical Mechanical Engineering: Core Qualification: Compulsory |
| Process Engineering: Core Qualification: Compulsory |
| Water and Environmental Engineering: Core Qualification: Compulsory |

| Course L2888: Practical term | 1 2 (dual study program, Master's degree) |
|------------------------------|---|
| Тур | |
| Hrs/wk | 0 |
| СР | 10 |
| Workload in Hours | Independent Study Time 300, Study Time in Lecture 0 |
| Lecturer | Dr. Henning Haschke |
| Language | DE |
| Cycle | WiSe/SoSe |
| Content | Company onboarding process |
| | Assigning a professional field of activity as an engineer (B.Sc.) and associated fields of work Establishing responsibilities and authorisation of the dual student within the company as an engineer (B.Sc.) Taking personal responsibility within a team and on selected projects - across departments and, if applicable, across companies Scheduling the current practical module with a clear correlation to work structures Scheduling the examination phase/subsequent study semester Operational knowledge and skills Company-specific: Responsibility as an engineer (B.Sc.) in their own area of work, coordinating team and project work, dealing with complex contexts and unsolved problems, developing and implementing innovative solutions Subject specialisation (corresponding to the chosen course [M.Sc.]) in the field of activity Systemic skills Implementing the university's application recommendations (theory-practice transfer) in corresponding work and task areas across the company |
| | Sharing/reflecting on learning |
| | Updating their e-portfolio Importance of course contents (M.Sc.) when working as an engineer Importance of development and innovation when working as an engineer |
| Literature | Studierendenhandbuch Betriebliche Dokumente Hochschulseitige Anwendungsempfehlungen zum Theorie-Praxis-Transfer |

| Courses | | | | |
|-------------------------------------|--|--|---|--------------------------|
| Title | | Тур | Hrs/wk | СР |
| Practical term 3 (dual study progra | m, Master's degree) (L2889) | | 0 | 10 |
| Module Responsible | | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Successful completion of practical modulecourse E from the module on interlinking the | • | | |
| Educational Objectives | After taking part successfully, students have read | hed the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Dual students | | | |
| | combine their comprehensive and spe- strategy-oriented practical knowledge gain have a critical understanding of the pri implementing innovations. | ed from their current field of work a | nd area of responsibility. | |
| Skills | Dual students | | | |
| | apply specialised and conceptual skills evaluate the associated work processes an implement the university's application re develop new solutions as well as proceed when facing frequently changing requirem can use academic methods to develop these with regard to their usability. | d results, taking into account differe ecommendations with regard to thei dures and approaches to implement ents and unpredictable changes (sys | ent possible courses of act r current tasks. coperational projects and stemic skills). | ion. assignments - ev |
| Personal Competence | | | | |
| Social Competence | Dual students | | | |
| | work responsibly in cross-departmenta their team. can promote the professional development | ent of others in a targeted manner. | | |
| | represent complex and interdisciplinary with internal and external stakeholders and | | plems and solution appro- | aches in discussio |
| Autonomy | Dual students | | | |
| | reflect on learning and work processes i define goals for new application-oriente company and the public. reflect on the relevance of areas of university's application recommendations and practice. | d tasks, projects and innovation pla | rk as an engineer, and | also implement t |
| Workload in Hours | Independent Study Time 300, Study Time in Lect | ure 0 | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | Written elaboration | | | |
| Examination duration and scale | Documentation accompanying studies and across development report (e-portfolio). This document interlinking theory and practice, as well as p dual@TUHH Coordination Office that the dual stur | s and reflects individual learning ex rofessional practice. In addition, t | operiences and skills deve he partner company pro | elopment relating |
| Assignment for the | Civil Engineering: Core Qualification: Compulsory | | | |
| Following Curricula | Bioprocess Engineering: Core Qualification: Comp | ulsory | | |
| | Chemical and Bioprocess Engineering: Core Quali | fication: Compulsory | | |
| | Computer Science: Core Qualification: Compulsor | у | | |
| | Data Science: Core Qualification: Compulsory | son | | |
| | Electrical Engineering: Core Qualification: Compu Energy Systems: Core Qualification: Compulsory | SOLA | | |
| | Environmental Engineering: Core Qualification: Co | ompulsory | | |
| | Aircraft Systems Engineering: Core Qualification: | | | |
| | Computer Science in Engineering: Core Qualificat | | | |
| | Information and Communication Systems: Core Q | | | |
| | International Management and Engineering: Core Logistics, Infrastructure and Mobility: Core Qualifi | | | |
| | • | cation. Compuisory | | |
| | Materials Science and Engineering: Core Qualifica | tion: Compulsory | | |
| | Aeronautics: Core Qualification: Compulsory Materials Science and Engineering: Core Qualifica | | | |

Module Manual M.Sc. "Civil Engineering"

| Materials Science: Core Qualification: Compulsory |
|---|
| Mechanical Engineering and Management: Core Qualification: Compulsory |
| Mechatronics: Core Qualification: Compulsory |
| Biomedical Engineering: Core Qualification: Compulsory |
| Microelectronics and Microsystems: Core Qualification: Compulsory |
| Product Development, Materials and Production: Core Qualification: Compulsory |
| Renewable Energies: Core Qualification: Compulsory |
| Naval Architecture and Ocean Engineering: Core Qualification: Compulsory |
| Theoretical Mechanical Engineering: Core Qualification: Compulsory |
| Process Engineering: Core Qualification: Compulsory |
| Water and Environmental Engineering: Core Qualification: Compulsory |

| Course L2889: Practical term | n 3 (dual study program, Master's degree) |
|------------------------------|--|
| Тур | |
| Hrs/wk | 0 |
| CP | 10 |
| Workload in Hours | Independent Study Time 300, Study Time in Lecture 0 |
| Lecturer | Dr. Henning Haschke |
| Language | DE |
| Cycle | WiSe/SoSe |
| Content | Company onboarding process |
| | Assigning a future professional field of activity as an engineer (M.Sc.) and associated fields of work Extending responsibilities and authorisation of the dual student within the company up to the intended first assignment after completing their studies Working responsibly in a team; project responsibility within own area - as well as across divisions and companies if necessary Scheduling the final practical module with a clear correlation to work structures Internal agreement on a potential topic or innovation project for the Master's dissertation Planning the Master's dissertation within the company in cooperation with TU Hamburg Scheduling the examination phase/subsequent study semester |
| | Operational knowledge and skills |
| | Company-specific: dealing with change, project and team development, responsibility as an engineer in their future field of work (M.Sc.), dealing with complex contexts, frequent and unpredictable changes, developing and implementing innovative solutions Specialising in one field of work (final dissertation) Systemic skills Implementing the university's application recommendations (theory-practice transfer) in corresponding work and task areas across the company |
| | Sharing/reflecting on learning E-portfolio |
| | Relevance of study content and personal specialisation when working as an engineer Relevance of research and innovation when working as an engineer |
| Literature | Studierendenhandbuch betriebliche Dokumente Hochschulseitige Anwendungsempfehlungen zum Theorie-Praxis-Transfer |

Specialization Coastal Engineering

| Module M0699: Geote | echnics III | | | |
|----------------------------------|--|--|------------------------|------------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Numerical Methods in Geotechnics | (L0375) | Lecture | 3 | 3 |
| Advanced Foundation Engineering | (L0497) | Lecture | 2 | 2 |
| Advanced Foundation Engineering | (L0498) | Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof. Jürgen Grabe | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Geotechnics I and II, Mathematics I-III | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reac | hed the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After successfully completing the module, studen | ts will be able to | | |
| | describe individual procedures for the geot | echnical monitoring of civil engineering | measures | |
| | reproduce exploration and investigation m | | ilcusules, | |
| | select suitable types of field and laboratory | | ate their results | |
| | state the differences between various street | | | variants of the stress |
| | and distortion tensor, | so and deformation states and the physic | an significance of in | variants of the stress |
| | outline the standard and special soil mecha | anics tests used to determine the stress- | strain behavior of so | il. |
| | describe continuum models and the resulti | | | , |
| | as well as define boundary value problems | | ng in such a wav tha | t they can be solved |
| | unambiguously. | | 5 | 2 |
| Skills | Students will be able to | | | |
| | | | | |
| | dimension vertical drains for soil improvement of soft soils, calculate depth compaction using various appropriate methods, apply principles of horizontal bearing capacity of piles, verify the internal and external stability of fluid-supported diaphragm walls, evaluate the boundary conditions for the design of a deep excavation and design the individual components of the excavation | | | |
| | | | | |
| | | | | |
| | | | | components of the |
| | | | | |
| | excavation, | | | |
| | perform, evaluate and interpret tests for the description and classification of soils according to applicable standards, computationally implement numerical algorithms to solve boundary value problems | | | |
| | computationally implement numerical algorithms to solve boundary value problems, select and apply the types of analyses depending on the degree of saturation, the impact, and the material behavior | | | |
| | determine appropriate model parameters for different possibilities and limitations of material models for the grain structu | | | |
| | of soils. | | | , the grain budecare |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Students can work in groups and support each ot | her in finding solutions. | | |
| Autonomy | Students are able to assess their own strengths a and think in terms of processes. | nd weaknesses and, based on this, organ | nize their time and le | earning management |
| | | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lectur | re 84 | | |
| Credit points | | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engine | eering: Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Eng | gineering: Compulsory | | |
| | Civil Engineering: Specialisation Coastal Engineer | • • • | | |
| | Civil Engineering: Specialisation Water and Traffic | | | |
| | Civil Engineering: Specialisation Computational En | | | |
| | International Management and Engineering: Spec | cialisation II. Civil Engineering: Elective Co | ompulsory | |

| Course L0375: Numerical Me | Course L0375: Numerical Methods in Geotechnics | | |
|----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 3 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | |
| Lecturer | Dr. Hans Mathäus Stanford | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Topics: | | |
| | Introduction to numerical soil mechanics Introduction to numerical mathematics Finite Element Method (analysis procedures, algorithms) Finite Element Method (application in geotechnical engineering) | | |
| Literature | Wriggers P. (2001): Nichtlineare Finite-Elemente-Methoden. Springer Wriggers P. (2008): Nonlinear Finite Element Methods. Springer Deutsche Gesellschaft für Geotechnik e.V. (Hrsg., 2014): Empfehlungen des Arbeitskreises "Numerik in der Geotechnik". Ernst & Sohn | | |

| Course L0497: Advanced Fou | Indation Engineering |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Jürgen Grabe |
| Language | DE |
| Cycle | WiSe |
| Content | Vertical drains Piles Ground improvement (Deep Compaction, Soil mixing) Vibration driving Jet grouting Slurry wall Deep excavation |
| Literature | EAK (2002): Empfehlungen für Küstenschutzbauwerke EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke EAB (1988): Empfehlungen des Arbeitskreises Baugruben Grundbau-Taschenbuch, Teil 1-3, (1997), Ernst & Sohn Verlag |

| Course L0498: Advanced Fou | ourse L0498: Advanced Foundation Engineering | |
|----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Jürgen Grabe | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | | |
|--|---|--|---------------------------------------|--------|----|
| Title | | | Тур | Hrs/wk | CP |
| Applied Tunnel Constructions (L24) | | | Lecture | 2 | 3 |
| Introduction to tunnel construction Introduction to tunnel construction | | | Lecture Recitation Section (large) | 1 | 2 |
| Module Responsible | | | Rectation Section (large) | 1 | - |
| Admission Requirements | | | | | |
| Recommended Previous | | idias Civil and anvironma | ntal anginagring. | | |
| Kecommended Previous Knowledge | Modules from Bachelor st | | ntal engineering: | | |
| Kilowieuge | Geotechnics I-II | | | | |
| Educational Objectives | | | | | |
| Professional Competence | Arter taking part successi | After taking part successfully, students have reached the following learning results | | | |
| | Knowledge of different tunnel construction types as well as special methods and techniques of subsoil construction. | | | | |
| - | Basic knowledge of tunnel design as well as practical skills in structural tunnel analysis. | | | | |
| Personal Competence | basic knowledge of turner design as well as practical skills in structural tunnel analysis. | | | | |
| - | Capacity for teamwork concerning project management and design of tunnels. | | | | |
| , | Promotion of independent and creative work flow in the framework of a design exercise. | | | | |
| | Independent Study Time 124, Study Time in Lecture 56 | | | | |
| Credit points | | | | | |
| Course achievement Compulsory Bonus Form Description | | | | | |
| course demovement | | cercises | | | |
| Examination | Written exam | | | | |
| Examination duration and | 120 minutes | | | | |
| scale | | | | | |
| Assignment for the | Civil Engineering: Speciali | sation Structural Enginee | ring: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Speciali | sation Geotechnical Engir | neering: Compulsory | | |
| | Civil Engineering: Speciali | sation Coastal Engineerin | g: Compulsory | | |
| | Civil Engineering: Speciali | sation Water and Traffic: | Elective Compulsory | | |
| | Civil Engineering: Speciali | sation Computational Eng | ineering: Elective Compulsory | | |
| | | | | | |

| Course L2407: Applied Tunnel Constructions | |
|--|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Jürgen Grabe, Tim Babendererde |
| Language | DE |
| Cycle | WiSe |
| Content | |
| Literature | |

| Course L0707: Introduction t | o tunnel construction |
|------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Dr. Julian Bubel |
| Language | DE |
| Cycle | WiSe |
| Content | Definitions Historical development in tunneling Geology for tunneling Hard rock tunneling (construction composite and machines) Tunnelung in temporarly stable soil with conventional construction methods Tunneling in soft soils (form of supports, shield types, compressed air application) Pipe jacking Tunnel Lining, tunnel supporting structures Calculation approaches for supporting structures in shield-driven tunnels Surveying for tunneling Safety requirements Construction Contract Literature and sources |
| Literature | • Vorlesung/Übung s. www.tu-harburg.de/gbt |

| Course L1811: Introduction to tunnel construction | |
|---|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Julian Bubel |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| ect-/problem-based Learning | Hrs/wk | СР |
|-----------------------------|---------------------------------------|-------------------------|
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| Course L2867: Construction | Robotics |
|----------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 6 |
| СР | 6 |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 |
| Lecturer | Prof. Kay Smarsly, Jan Stührenberg |
| Language | EN |
| Cycle | WiSe |
| Content | Introduction: Robotics in civil engineering Presentation of potential topics Programming of algorithms in Python Application of software systems: LINUX distribution, ROS, CloudCompare, Application of hardware systems: Petoi Bittle Dog, Raspberry Pi, Arduino, sensing Topics considered for robotics using the Petoi Bittle Dog: Movement Use of sensors (camera, infrared,) Data structures/data acquisition Programming Topics technically relevant to building inspection: Geodetic evaluations Image processing Localization |
| Literature | Bock/Linner: Construction Robotics |
| | Verl et al.: Soft Robotics |
| | Pasquale: New Laws of robotics |

Module M0593: Building Materials and Building Preservation

| Courses | | | | | | |
|------------------------------------|---|---------------------|-----------------------|------------------------------|------------------|---------------------|
| Title | | | Тур | | Hrs/wk | СР |
| Repair of Structures (L0255) | | | Lectu | ıre | 1 | 1 |
| Mineral Building Materials (L0253) | | | Lectu | ire | 2 | 2 |
| Technology of mineral Building Mat | erials (L0256) | | Proje | ct-/problem-based Learning | 1 | 2 |
| Transport Processes in Building Ma | erials and Damage Processes (L02 | 54) | Lectu | ıre | 1 | 1 |
| Module Responsible | Prof. Frank Schmidt-Döhl | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Basic knowledge about buildir | ig materials, build | ing physics and bu | ilding chemistry, for exam | nple by the m | nodules Principles |
| Knowledge | Building Materials and Building | Physics and Buildin | ng Materials and Bui | lding Chemistry. | | |
| Educational Objectives | After taking part successfully, s | tudents have reac | hed the following lea | irning results | | |
| Professional Competence | | | | | | |
| Knowledge | The students are able to descri | be the components | s of mineral building | materials and their function | on in detail and | d to use them for t |
| | manufacture of special mineral | building materials | . They are able to sh | ow the characteristics of m | nineral buildin | g materials. They a |
| | able to describe the manufactu | re, properties and | fields of application | of special mortars and spe | cial concretes | and the correlation |
| | of their material parameters. Th | ney are able to sho | w the principles of a | nchor technology and desi | gn. | |
| Chille | The shudents are able to reaf- | | - f | | These and a bi | |
| SKIIIS | The students are able to perfor | | | - | | • • |
| | mineral mortar and to manufac | | | | | |
| | able to recognize damages, to and strengthening measures. | assess possible ca | auses, to use the fu | ndamentals of construction | n preservation | and to select rep |
| | | | | | | |
| Personal Competence | | | | | | |
| Social Competence | The students are able to develo | | | | | |
| | other students. In a critical discussion they defend and adjust their results. The students are able to manufacture their special | | | | | |
| | building material on the basis o | f this feedback. | | | | |
| | | | | | | |
| Autonomy | r The students are able to responsibly use the resources of materials and lab equipment for their project and to investigate and to | | | | | |
| | get missing components. | | | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | | | |
| Credit points | 6 | | | | | |
| Course achievement | Compulsory Bonus Form | | Description | | | |
| | Yes 20 % Subject | theoretical an | ıd | | | |
| | practica | l work | | | | |
| Examination | Written exam | | | | | |
| Examination duration and | 120 min | | | | | |
| scale | | | | | | |
| Assignment for the | Civil Engineering: Specialisatior | n Geotechnical Eng | ineering: Compulsor | У | | |
| Following Curricula | Civil Engineering: Specialisatior | n Coastal Engineeri | ing: Elective Compul | sory | | |
| | Civil Engineering: Specialisatior | n Structural Engine | ering: Elective Comp | oulsory | | |
| | Civil Engineering: Specialisatior | | | | | |

| Course L0255: Repair of Structures | | |
|------------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Frank Schmidt-Döhl | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Maintenance of structures, repair and strengthening, subsequent waterproofing of structures | |
| Literature | BetonMarketing Deutschland (Hrsg.): Stahlbetonoberflächen - schützen, erhalten, instandsetzen | |

| Course L0253: Mineral Buildi | ing Materials |
|------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Frank Schmidt-Döhl |
| Language | DE |
| Cycle | SoSe |
| Content | Components of mineral building materials and their function, binding materials, concrete and mortar, special mortars, special concretes |
| Literature | Taylor, H.F.W.: Cement Chemistry |
| | Springenschmid, R.: Betontechnologie für die Praxis |

| Course L0256: Technology of | Course L0256: Technology of mineral Building Materials | |
|-----------------------------|--|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Frank Schmidt-Döhl | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Design and production of a special mineral building material | |
| Literature | Taylor, H.F.W.: Cement Chemistry | |
| | Springenschmid, R.: Betontechnologie für die Praxis | |

| Course L0254: Transport Pro | Course L0254: Transport Processes in Building Materials and Damage Processes | | |
|-----------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Frank Schmidt-Döhl | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Transport Processes in Building Materials and Damage Processes | | |
| Literature | Blaich, J.: Bauschäden, Analyse und Vermeidung | | |

| Courses | | | | |
|---|--|---|---------------------|-------------|
| Title | | Тур | Hrs/wk | СР |
| Design of Prestressed Structures and Concreet Bridges (L0603) | | Lecture | 3 | 4 |
| Design of Prestressed Structures a | nd Concreet Bridges (L0604) | Recitation Section (large) | 2 | 2 |
| Module Responsible | NN | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Detailed knowledge on the design of concr | rete structures. | | |
| Knowledge | Madulaa, Dainfanaad Cananata Churchuraa I | U. Chrysteinel Analysia I. U. Mashanina I. U. Conser | -t- Church uno - | |
| | Modules: Reinforced Concrete Structures I | +II, Structural Analysis I+II, Mechanics I+II, Concre | ete Structures | |
| Educational Objectives | After taking part successfully, students have reached the following learning results | | | |
| Professional Competence | | | | |
| Knowledge | The students know the main bridge types, their applications and the various loads. They can explain the basic They can explain the design of a prestressed bridge. | | | |
| | | | | |
| CI-ill- | The students are able to design reinforced or prestressed concrete bridges. | | | |
| SKIIIS | The students are able to design reinforced | for prestressed concrete bridges. | | |
| Personal Competence | | | | |
| Social Competence | The students can design in teamwork a rea | al concrete bridge. | | |
| 4 | The students are able to desire a grant | | | |
| Αυτοποτηγ | The students are able to design a prestres | sed concrete bridge and discuss the problems and | i results with othe | r students. |
| Workload in Hours | Independent Study Time 110, Study Time | in Lecture 70 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 180 minutes | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural | Engineering: Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Coastal Er | ngineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Computat | ional Engineering: Elective Compulsory | | |
| | International Management and Engineering | | | |

| Course L0603: Design of Pre | stressed Structures and Concreet Bridges |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | NN |
| Language | DE |
| Cycle | SoSe |
| Content | prestressed structures |
| | basis of prestressed structures, field of application differences between reinforced and prestressed concrete structures history of prestressing construction materials: concrete, tendons, ducts, anchorage systems construction: prestressing methods prestressing forces and member forces (friction, elongation) tendon layout time dependant prestressing losses design of prestressed structures design of anchorage region non-bonded prestressing prestressed flat slabs |
| | Concrete bridges history of bridges design of bridges loads on bridges loads on bridges member forces for slab, T-beam, hollow box, frame and arch bridges precast bridges - precast segmental bridges bearings abutments, columns construction methods damages - checking of bridges |
| Literature | Vorlesungsumdruckim STUDiP Rombach, G. (2003): Spannbetonbau. Ernst & Sohn, Berlin Wicke, M. (2002): Anwendung des Spannbetons. Betonkalender 2002, Teil II, S. 113-180, Verlag Ernst & Sohn, Berlin Leonhardt, F. (1980): Vorlesungen über Massivbau. Teil 5: Spannbeton. Berlin Mehlhorn, G. (2007): Handbuch Brücken, Springer Verlag Schäfer, H.; Kaufeld, K. (1997): Massivbrücken. Betonkalender Teil II, S. 443ff, Ernst & Sohn, Berlin Menn, Ch. (1986): Stahlbetonbrücken. Springer Verlag, Wien |

| Course L0604: Design of Pre | stressed Structures and Concreet Bridges |
|-----------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | NN |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Courses | | | | |
|--------------------------------------|---|--|--------|----|
| Title | | Тур | Hrs/wk | СР |
| Digital Twinning in Civil Engineerin | g (L3136) | Lecture | 2 | 2 |
| Digital Twinning in Civil Engineerin | g (L3137) | Seminar | 2 | 4 |
| Module Responsible | Alexander Chmelnizkij | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students h | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | | | | |
| Skills | | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | | | | |
| Workload in Hours | Independent Study Time 124, Study Time | e in Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Presentation | | | |
| Examination duration and | 20 min presentation and 5 pages handou | t | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Compute | ational Engineering: Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Coastal | Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Geotech | nical Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Structura | al Engineering: Elective Compulsory | | |

| Course L3136: Digital Twinning in Civil Engineering | |
|---|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Alexander Chmelnizkij, Prof. Bastian Oesterle, Prof. Kay Smarsly |
| Language | DE |
| Cycle | SoSe |
| Content | |
| Literature | |

| Course L3137: Digital Twinn | Course L3137: Digital Twinning in Civil Engineering | |
|-----------------------------|--|--|
| Тур | Seminar | |
| Hrs/wk | 2 | |
| СР | 4 | |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 | |
| Lecturer | Alexander Chmelnizkij, Prof. Bastian Oesterle, Prof. Kay Smarsly | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Module M0827: Mode | ling in Water Management | | | |
|---|--|---|---------------|-----------------------|
| | , | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Groundwater Modeling using Modfle | | Lecture | 1 | 1 |
| Groundwater Modeling using Modfle Modeling of Water Supply Network | | Recitation Section (small) Project-/problem-based Learning | 2 | 2 3 |
| | | Project-/problem-based Learning | Z | 5 |
| Module Responsible Admission Requirements | | | | |
| Recommended Previous | | | | |
| Knowledge | Groundwater | | | |
| euge | groundwater hydraulics and transport of | substances | | |
| | Pipe Systems | | | |
| | | | | |
| | | res, in particular drinking water systemsand | urban drainag | e systems includin |
| | special structures | | | |
| | Hydraulics of drinking water supply syste Basis knowledge on water management | ms and sewer systems | | |
| | Basic knowledge on water management | | | |
| Educational Objectives | After taking part successfully, students have rea | ached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are able to describe the modelling of groundwater flow and transport as well as urban water infrastructures. Th | | | |
| | carry out systems analyses and can detect tech | nical and conceptual weak points within the sy | stems in case | studies. Besides the |
| | are able to analyse interdependencies of hydrau | lic and toxic phenomena in soil and water. | | |
| | | | | |
| | | | | |
| Skills | The students are able to construct and apply s | cientific groundwater models indipendently. Th | ey can work o | n different scenarios |
| | and can compare or assess different solutions for | or existing problems by application of selected s | oftware produ | cts. The students are |
| | able to use different software solutions (e.g. EP/ | ANET, EPA-SWMM). | | |
| | | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| | Wird nicht vermittelt. | | | |
| | | | | |
| Autonomy | Wird nicht vermittelt. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Leo | ture 70 | | |
| Credit points | | | | |
| Course achievement | None | | | |
| Examination | Oral exam | | | |
| Examination duration and | 30 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engin | neering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering | ngineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Coastal Enginee | ering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Water and Traf | fic: Elective Compulsory | | |
| | Civil Engineering: Specialisation Computational | Engineering: Elective Compulsory | | |
| | Water and Environmental Engineering: Specialis | ation Environment: Elective Compulsory | | |
| | Water and Environmental Engineering: Specialis | | | |
| | Water and Environmental Engineering: Specialis | ation Water: Elective Compulsory | | |

| Course L0543: Groundwater | Modeling using Modflow |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Sonja Götz |
| Language | DE/EN |
| Cycle | SoSe |
| Content | Introduction and application of the groundwater model MODFLOW (PMWIN); theoretical backround of the modell, students do work |
| | with the model PMWIN for practical case studies. |
| Literature | MODFLOW-Handbuch |
| | Chiang, Wen Hsien: PMWIN |
| | |

| Course L0544: Groundwater | Modeling using Modflow |
|---------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Sonja Götz |
| Language | DE/EN |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L0875: Modeling of V | Vater Supply Network |
|-----------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Dr. Klaus Johannsen |
| Language | DE |
| Cycle | SoSe |
| Content | |
| Literature | Mutschmann/Stimmelmayr: Taschenbuch der Wasserversorgung, 16. Auflage. Springer Vieweg - Verlag. Wiesbaden 2014. |

| Courses | | | | | |
|-------------------------------------|---|--|------------------------|---------------------------------------|--|
| Title | | Тур | Hrs/wk | СР | |
| Soil Mechanics - Selected Topics (L | 0374) | Lecture | 2 | 2 | |
| Soil Dynamics (L0452) | | Lecture | 2 | 2 | |
| Experimental Researches in Geote | hnics (L0706) | Practical Course | 2 | 2 | |
| Module Responsible | Prof. Jürgen Grabe | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Modules: Mathematics I-III, Mechanics I-II, Geotech | inics I | | | |
| Knowledge | Courses: Soil laboratory course, (Applied structura | l dynamics) | | | |
| Educational Objectives | After taking part successfully, students have reach | ned the following learning results | | | |
| Professional Competence | | | | | |
| | Students will be able to, | | | | |
| | describe wave propagation in the ground up | nder dynamic excitation and define the | e relevant parameters | , | |
| | to measure vibrations and to interpret the operations and to interpret the operations. | lata obtained with regard to their effec | ct on people and struc | tures, | |
| | justify when elastodynamic methods are su | fficient and when plastodynamic effec | ts must be taken into | account, | |
| | to reproduce the collapse theorems of plast | icity theory, | | | |
| | describe the viscous behavior of cohesive | soils and computationally account f | or creep deformation | and rate-depende | |
| | shear strengths | | | | |
| | as well as to determine the effect of partial | saturation on the seepage flow and th | e shear strength. | | |
| Skills | After the successful completion of the module the | students should be able to: | | | |
| | • to derive and apply the basic equation of a | simple mass oscillator, | | | |
| | to derive and apply the basic equation of a simple mass oscillator, to understand the wave propagation in the soil under dynamic excitation and to detect the relevant parameters, to know the essential laboratory and field tests to determine soil dynamic characteristics and to evaluate them, to design machine foundations to dynamic load, | | | | |
| | | | | | |
| | | | | | |
| | to design machine roundations to dynamic load, to measure shocks to perform vibration forecast, | | | | |
| | to evaluate shocks in terms of their effect of | | | | |
| | to evaluate possibilities of isolation, | | | | |
| | to understand mechanisms that cause earth | nguakes and evaluate earthquakes in t | terms of their magnitu | ide and intensity. | |
| | to know methods to determine axial pile ca | | | , , , , , , , , , , , , , , , , , , , | |
| | • to know the mechanisms that lead to a def | | | e these deformatio | |
| | mathematically, | | 5 | | |
| | to distinguish the area of application of the | method of elastodynamics and plasto | dynamics, | | |
| | to detect the undrained shear strength as a | | | | |
| | to capture the visous behaviour of cohesive | | | ent shear strength | |
| | calculations, | | | 5 | |
| | to consider the impact of the partly saturate | ed of a seepage and shear strength. | | | |
| | | | | | |
| Personal Competence | | | | | |
| Social Competence | Students will be able to work in teams to achieve | e results on measurement and experi | mental principles and | present their resu | |
| | together at the end of the semester. | | | | |
| Autonomy | Students are able to assess their own strengths ar | nd weaknesses and organize their time | e and learning manage | ement based on this | |
| | | | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture | e 84 | | | |
| Credit points | 6 | | | | |
| Course achievement | Compulsory Bonus Form | Description | | | |
| | Yes None Subject theoretical an practical work | d | | | |
| Examination | Written exam | | | | |
| Examination duration and | 135 min | | | | |
| scale | | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engine | ering: Elective Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Eng | | | | |
| - | Civil Engineering: Specialisation Coastal Engineeri | | | | |
| | Civil Engineering: Specialisation Computational En | | | | |

| Course L0374: Soil Mechanics - Selected Topics | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Dr. Hans Mathäus Stanford | |
| Language | DE | |
| Cycle | SoSe | |
| Content | selected topis: | |
| Literature | Stress-strain behaviour (experiments, observations, models) Hydraulic behaviour (experiments, observations, models) Physical modelling (similarity theory, 1g model tests, ng model tests) Limit and safety analysis (collapse theorems of plasticity theory, upper and lower bound analysis, limit equilibrium analysis, numerical analysis) Heat transport (heat conduction, convective heat transport, freezing/thawing) Kolymbas D. (2019): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. Springer Verlag, 5. Auflage Muir Wood D. (2004). Geotechnical modelling. CRC Press Nova, R. (2010). Soil mechanics. Wiley Verruijt, A. (2012). Soil mechanics. u r l: https://geo.verruijt.net Verruijt A. (2018). An introduction to soil mechanics. Vol. 30, Springer Series Theory and Applications of Transport in Porous Media | |

| Course L0452: Soil Dynamics | | |
|-----------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Anne Hagemann | |
| Language | DE | |
| Cycle | SoSe | |
| Content | • mass-spring-damper systems, | |
| | • wave propagation in soils, | |
| | dynamic soil parameters, | |
| | Determination of dynamic soil parameters, | |
| | • machine foundations, | |
| | • in-situ measurement of ground motion, ground motion prediction, evaluation of ground motion, | |
| | • ground motion shielding, | |
| | introduction into earthquake engineering, | |
| | • dynamic pile tests, | |
| | • cyclic accumulation, | |
| | • plastodynamics | |
| Literature | Das B.M.: Fundamentals of Soil Dynamics, Elsevier Empfehlungen des Arbeitskreises Baugrunddynamik. Hrsg. Deutsche Gesellschaft für Geotechnik (DGGT) Haupt W.: Bodendynamik. Vieweg und Teubner Meskouris K. und Hinzen KG.: Bauwerke und Erdbeben. Vieweg Verlag Studer J.A., Koller M.G. und Laue J.: Bodendynamik, Springer Verlag | |

| Course L0706: Experimental | Researches in Geotechnics | |
|----------------------------|--|--|
| Тур | Practical Course | |
| Hrs/wk | 2 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Dr. Hans Mathäus Stanford, Göta Bürkner | |
| Language | DE | |
| Cycle | SoSe | |
| Content | The students are supposed to: become acquainted with geotechnical model tests, field tests and laboratory tests as well as corresponding measurement techniques. These compromise amongst others inclinometer measurements and geophone measurements as well as high- | |
| | grade laboratory tests on the stress-strain relationship of soil specimens, e. g. triaxial tests, simple shear tests and resonant column tests. gain insight into current soil mechanical research. plan, coordinate, perform and evaluate soil mechanical tests in a team. discuss, reflect, review and present the obtained results in a group. | |
| | An important learning target is the introduction to scientific work for students who plan a scientific career, and for those who will work in practice with the responsibility to order corresponding tests and evaluate the results. | |
| | The practical laboratory work is based on annualy changing problems, which are however related to the experience and results of the preceding year's course group. | |
| Literature | - Grabe, J. (2004): Bodenmechanik und Grundbau, Band 3 der Veröffentlichungsreihe des Instituts für Geotechnik und Baubetrieb, Technische Universität Hamburg-Harburg. | |
| | - Kolymbas, D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. 2., korrigierte und ergänzte Auflage, Springer Verlag. | |
| | Normen zu geotechnischen Versuchsgeräten und Versuchsverfahren: DIN 18135:2012-04: Baugrund, Untersuchung von Bodenproben - Eindimensionaler Kompressionsversuch, Deutsches Institut für Normung, e. V. | |
| | - DIN 18137-2:2011-04: Baugrund, Untersuchung von Bodenproben - Bestimmung der Scherfestigkeit - Teil 2: Triaxialversuch, Deutsches Institut für Normung e. V. | |

| Courses | | | | |
|-------------------------------|---|--------------------------------------|----------------|-------------------|
| Title | | Тур | Hrs/wk | СР |
| Noise Protection (L1109) | | Lecture | 2 | 2 |
| Urban Infrastructures (L0874) | | Project-/problem-based Learning | 2 | 4 |
| Module Responsible | Dr. Dorothea Rechtenbach | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Knowledge on Urban planning | | | |
| Knowledge | Knowledge on measures for climate protection | | | |
| | General knowledge of scientific writing/working | | | |
| | General knowledge of scientific writing/working | | | |
| Educational Objectives | After taking part successfully, students have reached the follow | ing learning results | | |
| Professional Competence | | | | |
| Knowledge | Students can describe urban development corridors as well as | current and future urban environr | mental probler | ns. They are able |
| | explain the causes of environmental problems (like noise). | | | |
| | Students can specify applications for various technical innovati | ons and explain why these contri | bute to the im | provement of urb |
| | life. They can, for example, derive and discuss measures for eff | ective noise abatement. | | |
| Skille | Students are able to develop specific solutions for correc | ting existing or future environ | mont related | problems of ur |
| SKIIIS | development. They can define a range of conceptual and techn | | | |
| | paths. To solve specific urban environmental problems they c | | | - |
| | context. | | | |
| Personal Competence | | | | |
| • | The students can work together in international groups. | | | |
| · | | | | |
| Autonomy | my Students are able to organize their work flow to prepare themselves for presentations and contributions to the discu | | | e discussions. Th |
| | can acquire appropriate knowledge by making enquiries indepe | ndently. | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | Written Report plus oral Presentation | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Elective | e Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Elec | tive Compulsory | | |
| | Civil Engineering: Specialisation Coastal Engineering: Elective C | Compulsory | | |
| | Civil Engineering: Specialisation Water and Traffic: Elective Con | npulsory | | |
| | Environmental Engineering: Core Qualification: Elective Compu | sory | | |
| | Joint European Master in Environmental Studies - Cities and Sus | tainability: Core Qualification: Cor | mpulsory | |
| | Logistics, Infrastructure and Mobility: Specialisation Infrastructu | re and Mobility: Elective Compuls | ory | |
| | Water and Environmental Engineering: Specialisation Environm | ent: Elective Compulsory | | |
| | Water and Environmental Engineering. Specialisation Environme | ent. Liective compuisory | | |

| Course L1109: Noise Protection | | |
|--------------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Martin Jäschke | |
| Language | EN | |
| Cycle | SoSe | |
| Content | | |
| Literature | 1) Müller & Möser (2013): Handbook of Engineering Acoustics (also available in German) | |
| | 2) WHO (1999): Guidelines for Community Noise | |
| | 3) Environmental Noise Directive 2002/49/EG | |
| | 4) ISO 9613-2 (1996): Acoustics, Attenuation of sound during propagation outdoors, Part 2: General method of calculation | |

| Course L0874: Urban Infrast | urse L0874: Urban Infrastructures | | |
|-----------------------------|---|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 2 | | |
| СР | 4 | | |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 | | |
| Lecturer | Dr. Dorothea Rechtenbach | | |
| Language | EN | | |
| Cycle | SoSe | | |
| Content | Problem Based Learning | | |
| | Main topics are: | | |
| | Central vs. Decentral Wastewater Treatment. | | |
| | Compaction of Cities. Car Free Cities. | | |
| | Multifunctional Places in Cities. | | |
| | The Sustainability of Freight Transport in Cities. | | |
| | | | |
| | | | |
| Literature | Depends on chosen topic. | | |

| Courses | | | | |
|-------------------------------------|---|--------------------------------------|--------------------|-------------------|
| Title | | Тур | Hrs/wk | СР |
| Harbour Engineering (L0809) | | Lecture | 2 | 2 |
| Harbour Engineering (L1414) | | Project-/problem-based Learning | 1 | 2 |
| Port Planning and Port Construction | n (L0378) | Lecture | 2 | 2 |
| Module Responsible | Prof. Peter Fröhle | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basics of coastal engineering | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the follo | wing learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are able to define in details and to choose desi | gn approaches for the functional c | lesign of a po | rt and apply ther |
| | design tasks. They can design the fundamental elements of a port. | | | |
| Chille | The students are able to calest and apply appropriate approach | has for the functional design of no | rta | |
| SKIIIS | The students are able to select and apply appropriate approad | thes for the functional design of po | rts. | |
| Personal Competence | | | | |
| Social Competence | Social Competence The students are able to deploy their gained knowledge in applied problems such as the functional design of p | | of ports. Addition | |
| | they will be able to work in team with engineers of other disci | olines. | | |
| Autonomy | The students will be able to independently extend their knowledge | edge and apply it to new problems | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | The duration of the examination is 150 min. The examination | on includes tasks with respect to | the general u | understanding of |
| scale | lecture contents and calculations tasks. | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Electi | ve Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Coastal Engineering: Compulsory | | | |
| | Civil Engineering: Specialisation Water and Traffic: Elective Co | mpulsory | | |
| | International Management and Engineering: Specialisation II. | Civil Engineering, Elective Compute | | |

| Course L0809: Harbour Engineering | | |
|-----------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Peter Fröhle | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Fundamentals of harbor engineering Maritime transportation and waterways engineering Ships Elements of harbors Harbor approaches and water-side harbor areas Terminal design and handling of cargo Quay-walls and piers Equipment of harbors Sluices and other special constructions Connection to inland transportation / inland waterway transportation Protection of harbors Breakwaters and Jetties Wave protection of harbors Fishery and other small harbors | |
| Literature | Brinkmann, B.: Seehäfen, Springer 2005 | |

Module Manual M.Sc. "Civil Engineering"

| ourse L1414: Harbour Engineering | | |
|----------------------------------|---|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Peter Fröhle | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L0378: Port Planning | and Port Construction | | |
|-----------------------------|---|--|--|
| Тур | ecture | | |
| Hrs/wk | | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Frank Feindt | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Planning and implementation of major projects Market analysis and traffic relations Planning process and plan Port planning in urban neighborhood Development of the logistics center "Port of Hamburg" in the metropolis Quays and waterfront structure Special planning Law Harbor - securing of a flexible use of the port Dimensioning of quays Flood protection structures Port of Hamburg - Infrastructure and development Preparation of areas Scour formation in front of shore structures | | |
| Literature | Vorlesungsumdruck, s. www.tu-harburg.de/gbt | | |

| Courses | | | | |
|--|--|--------------------------------------|---------------------|---------------------|
| Title | | Түр | Hrs/wk | СР |
| Hydraulic Models (L0813) | | Project-/problem-based Learning | 1 | 1 |
| Modelling of Waves (L0812) | | Project-/problem-based Learning | 1 | 1 |
| Modelling of Flow in Rivers and Est | Jaries (L0810) | Lecture | 3 | 4 |
| Module Responsible | Prof. Peter Fröhle | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Coastal Hydraulic Engineering I | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the following learning results | | | |
| Professional Competence | | | | |
| Knowledge Students are able to define in detail the basic processes that are related to the modelling of flows | | of flows in hy | ydraulic engineerir | |
| | Besides, they can describe the basic aspects of numerical m | odelling and actual numerical mod | lels for the sir | nulation of flows a |
| | waves. | | | |
| Skille | Students are able to apply hydrodynamic-numerical models t | practical hydraulic engineering ta | eke | |
| JKIIIS | Students are able to apply hydrodynamic-humencar models t | b practical hydraulic engineering ta | 585. | |
| Personal Competence | | | | |
| Social Competence | tence The students are able to deploy their gained knowledge in simple applied problems. Additionaly, they will be able to v | | able to work in tea | |
| | with others. | | | |
| Autonomy | The students will be able to independently extend their know | edge and apply it to new problems | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | The duration of the examination is 3 hours. The examination includes tasks with respect to the general understanding of t | | | |
| scale | lecture contents and calculations tasks. | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Elect | ve Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: El | ective Compulsory | | |
| | Civil Engineering: Specialisation Coastal Engineering: Elective | Compulsory | | |
| | Civil Engineering: Specialisation Computational Engineering: | | | |

| Course L0813: Hydraulic Models | | | |
|--------------------------------|--|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | | | |
| СР | | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Peter Fröhle | | |
| Language | DE/EN | | |
| Cycle | SoSe | | |
| Content | Fundamentals of hydraulic models Model laws Pi theorem of Buckingham Practical examples of hydraulic models | | |
| Literature | Strobl, Zunic: Wasserbau, Kap. 11 Hydraulische Modelle, Springer | | |

| Course L0812: Modelling of Waves | | | |
|----------------------------------|--|--|--|
| Тур | oject-/problem-based Learning | | |
| Hrs/wk | | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Peter Fröhle | | |
| Language | DE/EN | | |
| Cycle | SoSe | | |
| Content | Waves, interactions with shallow water and constructions Wave theories Sea state and surges Development of waves Wave spectra Modelling of Waves / phase averaged and phase resolved models Application of a phase averaged model for wave prediction (SWAN) Application of phase resolved wave models (Mike) | | |
| Literature | Vorlesungsumdruck | | |

| | low in Rivers and Estuaries |
|-------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Edgar Nehlsen, Prof. Peter Fröhle |
| Language | EN |
| Cycle | SoSe |
| Content | Introduction to numerical flow modelling Processes affecting tht flow Examples and applications of numerical models Procedure of numerical modelling Model concept |
| | Basic equations of hydrodynamics Saint-Venant equations Euler Equations Navier-Stokes equations Reynolds-averaged Navier-Stokes equations Shallow water equations |
| | Solving schemes • Numerical discretization • Solution algorithms • Convergence |
| Literature | Vorlesungsskript |
| | Literaturempfehlungen Bund der Ingenieure für Wasserwirtschaft, Abfallwirtschaft und Kulturbau (1997): Hydraulische Berechnung von naturnahen Fließgewässern. Düsseldorf: BWK (BWK-Merkblatt). Chow, Ven-te (1959): Open-channel Hydraulics. New York usw.: McGraw-Hill (McGraw-Hill Civil Engineering Series). Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (DWA); DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische Modelle, DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische (2019a): Merkblatt DWA-M 543-2 Geodaten in der Fließgewässermodellierung Teil 1: Geodaten in der Fließgewässermodellierung. Februar 2019. Hennef: Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall (DWA-Regelwerk, 543-1). |
| | Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (DWA); DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische Modelle, DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische (2019b): Merkblatt DWA-M 543-2 Geodaten in der Fließgewässermodellierung Teil 2: Bedarfsgerechte Datenerfassung und -aufbereitung. Februar 2019. Hennef: Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall (DWA-Regelwerk, 543-2). |
| | Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (DWA); DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische Modelle, DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische (2019c): Merkblatt DWA-M 543-3 Geodaten in der Fließgewässermodellierung - Teil 3: Aspekte der Strömungsmodellierung und Fallbeispiele. Februar 2019. Hennef: Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall (DWA-Regelwerk, 543-3). |
| | Hervouet, Jean-Michel (2007): Hydrodynamics of free surface flows. Modelling with the finite element method. Chichester: Wiley Online verfügbar unter http://www.loc.gov/catdir/enhancements/fy0741/2007296953-b.html. |
| | IAHR (2015): Professional Specifications for Physical and Numerical Studies in Environmental Hydraulics. In: Hydrolink (3/2015), S 90-92. |
| | Olsen, Nils Reidar B. (2012): Numerical Modelling and Hydraulics. 3. Aufl. Department of Hydraulic and Environmental Engineering The Norwegian University of Science and Technology. |
| | Szymkiewicz, Romuald (2010): Numerical modeling in open channel hydraulics. Dordrecht: Springer (Water science and technology library, 83). |
| | van Waveren, Harold (1999-): Good modelling practice handbook. [Utrecht], Lelystad, Den Haag: STOWA; Rijkswaterstaat-RIZA SDU, afd. SEO/RIZA [etc. distr.] (Nota, nr. 99.036). |
| | Zielke, Werner (Hg.) (1999): Numerische Modelle von Flüssen, Seen und Küstengewässern. Deutscher Verband für Wasserwirtschaft und Kulturbau. Bonn: Wirtschafts- und VerlGes. Gas und Wasser (Schriftenreihe des Deutschen Verbandes für Wasserwirtschaft und Kulturbau, 127). |

| Module M0874: Wast | ewater Systems | | | |
|--|--|---|------------------------|----------------------|
| | | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Biological Wastewater Treatment (I | | Lecture | 2 | 2 |
| Biological Wastewater Treatment (| | Recitation Section (large |) 1 2 | 1 |
| Advanced Wastewater Treatment (Advanced Wastewater Treatment (| | Lecture Recitation Section (large | - | 2 1 |
| | | |) 1 | 1 |
| Module Responsible | | | | |
| Admission Requirements | None | | | |
| | Knowledge of wastewater management | and the key processes involved in wastewater t | reatment. | |
| Knowledge | | | | |
| | After taking part successfully, students I | nave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | | f the full range of treatment systems in waste v | - | |
| | dependence for sustainable water prote- | ction. They can describe relevant economic, env | ironmental and socia | factors. |
| Skills | Students are able to pre-design and ex | plain the available wastewater treatment proc | esses and the scone | of their application |
| SKIIS | municipal and for some industrial treatm | | | or their application |
| | indificipal and for some madstral clean | iene pianes. | | |
| Personal Competence | | | | |
| Social Competence | Social skills are not targeted in this module. | | | |
| | | | | |
| Autonomy | | a subject and to organize their work flow inde | ependently. They can | also present on t |
| | subject. | | | |
| Workload in Hours | Independent Study Time 96, Study Time | in Lecture 84 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structur | al Engineering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotech | nnical Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Coastal | Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Water a | nd Traffic: Compulsory | | |
| | Bioprocess Engineering: Specialisation A | - General Bioprocess Engineering: Elective Con | pulsory | |
| | Environmental Engineering: Specialisation | on Water Quality and Water Engineering: Electiv | e Compulsory | |
| | International Management and Engineer | ing: Specialisation II. Process Engineering and B | iotechnology: Elective | e Compulsory |
| | International Management and Engineer | ing: Specialisation II. Energy and Environmental | Engineering: Elective | Compulsory |
| | Process Engineering: Specialisation Envi | ronmental Process Engineering: Elective Compu | lsory | |
| | Process Engineering: Specialisation Proc | ess Engineering: Elective Compulsory | | |
| | Water and Environmental Engineering: S | Specialisation Water: Compulsory | | |
| | Water and Environmental Engineering: S | Specialisation Environment: Elective Compulsory | | |
| | Water and Environmental Engineering: S | Specialisation Cities: Compulsory | | |

| Course L0517: Biological Wastewater Treatment | | |
|---|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Dr. Joachim Behrendt | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | Charaterisation of Wastewater | |
| | Metobolism of Microorganisms | |
| | Kinetic of mirobiotic processes | |
| | Calculation of bioreactor for wastewater treatment | |
| | Concepts of Wastewater treatment | |
| | Design of WWTP | |
| | Excursion to a WWTP | |
| | Biofilms | |
| | Biofim Reactors | |
| | Anaerobic Wastewater and sldge treatment | |
| | resources oriented sanitation technology | |
| | Future challenges of wastewater treatment | |
| Literature | Gujer, Willi | |
| | Siedlungswasserwirtschaft : mit 84 Tabellen | |
| | | |

| ISBN: 3540343296 (Gb.) URL: http://www.gbv.de/dms/bs/toc/516261924.pdf URL: http://deposit.d-nb.de/cgi-bin/dokserv? |
|--|
| id=2842122&prov=M&dok_var=1&dok_ext=htm |
| Berlin [u.a.] : Springer, 2007 |
| TUB_HH_Katalog |
| Henze, Mogens |
| Wastewater treatment : biological and chemical processes |
| ISBN: 3540422285 (Pp.) |
| Berlin [u.a.] : Springer, 2002 |
| TUB_HH_Katalog |
| Imhoff, Karl (Imhoff, Klaus R.;) |
| Taschenbuch der Stadtentwässerung : mit 10 Tafeln |
| ISBN: 3486263331 ((Gb.)) |
| München [u.a.] : Oldenbourg, 1999 |
| TUB_HH_Katalog |
| Lange, Jörg (Otterpohl, Ralf; Steger-Hartmann, Thomas;) |
| Abwasser : Handbuch zu einer zukunftsfähigen Wasserwirtschaft |
| ISBN: 3980350215 (kart.) URL: http://www.gbv.de/du/services/agi/52567E5D44DA0809C12570220050BF25/000000700334 |
| Donaueschingen-Pfohren : Mall-Beton-Verl., 2000 |
| TUB_HH_Katalog |
| Mudrack, Klaus (Kunst, Sabine;) |
| Biologie der Abwasserreinigung : 18 Tabellen |
| ISBN: 382741427X URL: http://www.gbv.de/du/services/agi/94B581161B6EC747C1256E3F005A8143/420000114903 |
| Heidelberg [u.a.] : Spektrum, Akad. Verl., 2003 |
| TUB_HH_Katalog |
| Tchobanoglous, George (Metcalf & Eddy, Inc., ;) |
| Wastewater engineering : treatment and reuse |
| ISBN: 0070418780 (alk. paper) ISBN: 0071122508 (ISE (*pbk)) |
| Boston [u.a.] : McGraw-Hill, 2003 |
| TUB_HH_Katalog |
| Henze, Mogens |
| Activated sludge models ASM1, ASM2, ASM2d and ASM3 |
| ISBN: 1900222248 |
| London : IWA Publ., 2002 |
| TUB_HH_Katalog |
| Kunz, Peter |
| Umwelt-Bioverfahrenstechnik |
| Vieweg, 1992 |
| Bauhaus-Universität., Arbeitsgruppe Weiterbildendes Studium Wasser und Umwelt (Deutsche Vereinigung für |
| Wasserwirtschaft, Abwasser und Abfall, ;) |
| Abwasserbehandlung : Gewässerbelastung, Bemessungsgrundlagen, Mechanische Verfahren, Biologische Verfahren, Reststoffe |
| aus der Abwasserbehandlung, Kleinkläranlagen |
| ISBN: 3860682725 URL: http://www.gbv.de/dms/weimar/toc/513989765_toc.pdf URL: |
| http://www.gbv.de/dms/weimar/abs/513989765_abs.pdf |
| Weimar : Universitätsverl, 2006 |
| TUB_HH_Katalog |
| Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall |
| DWA-Regelwerk |
| Hennef : DWA, 2004 |
| TUB_HH_Katalog |
| Wiesmann, Udo (Choi, In Su; Dombrowski, Eva-Maria;) |
| Fundamentals of biological wastewater treatment |
| ISBN: 3527312196 (Gb.) URL: http://deposit.ddb.de/cgi-bin/dokserv?id=2774611&prov=M&dok_var=1&dok_ext=htm |
| Weinheim : WILEY-VCH, 2007 |
| TUB_HH_Katalog |
| |

| Course L3122: Biological Wa | urse L3122: Biological Wastewater Treatment | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| CP | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Dr. Joachim Behrendt | | |
| Language | DE/EN | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Course L0357: Advanced Wastewater Treatment | | |
|---|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Dr. Joachim Behrendt | |
| Language | EN | |
| Cycle | SoSe | |
| Content | Survey on advanced wastewater treatment | |
| | reuse of reclaimed municipal wastewater | |
| | Precipitation | |
| | Flocculation | |
| | Depth filtration | |
| | Membrane Processes | |
| | Activated carbon adsorption | |
| | Ozonation | |
| | "Advanced Oxidation Processes" | |
| | Disinfection | |
| Literature | Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003 | |
| | Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987 | |
| | Membranverfahren: Grundlagen der Modul- und Anlagenauslegung, T. Melin und R. Rautenbach, Springer-Verlag, Berlin 2007 | |
| | Trinkwasserdesinfektion: Grundlagen, Verfahren, Anlagen, Geräte, Mikrobiologie, Chlorung, Ozonung, UV-Bestrahlung, | |
| | Membranfiltration, Qualitätssicherung, W. Roeske, Oldenbourg-Verlag, München 2006 | |
| | Organische Problemstoffe in Abwässern, H. Gulyas, GFEU, Hamburg 2003 | |

| Course L0358: Advanced Wa | stewater Treatment |
|---------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Joachim Behrendt |
| Language | EN |
| Cycle | SoSe |
| Content | Aggregate organic compounds (sum parameters) |
| | Industrial wastewater |
| | Processes for industrial wastewater treatment |
| | Precipitation |
| | Flocculation |
| | Activated carbon adsorption |
| | Recalcitrant organic compounds |
| | |
| Literature | Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003 |
| | Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987 |
| | Membranverfahren: Grundlagen der Modul- und Anlagenauslegung, T. Melin und R. Rautenbach, Springer-Verlag, Berlin 2007 |
| | Trinkwasserdesinfektion: Grundlagen, Verfahren, Anlagen, Geräte, Mikrobiologie, Chlorung, Ozonung, UV-Bestrahlung, Membranfiltration, Qualitätssicherung, W. Roeske, Oldenbourg-Verlag, München 2006 |
| | Organische Problemstoffe in Abwässern, H. Gulyas, GFEU, Hamburg 2003 |

| Module M0922: City F | |
|--------------------------------|--|
| Courses | |
| Гitle | Typ Hrs/wk CP |
| City Planning (L1066) | Project-/problem-based Learning 4 6 |
| Module Responsible | Prof. Carsten Gertz |
| Admission Requirements | None |
| Recommended Previous | for "Principles of Urban Planning": none |
| Knowledge | for "Designing Urban Streetscapes": some knowledge of transport planning, e.g. through taking the undergraduate class "Trans |
| | Planning and Traffic Engineering" |
| | |
| | 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: |
| Kilowiedge | |
| | use technical terms of urban planning. |
| | describe the main determinants of urban development. |
| | explain and compare different possibilities of how urban development can be influenced. |
| | discuss requirements for public streetscapes. |
| | explain the importance of street design. |
| Skills | Students are able to: |
| | |
| | read and analyze urban development concepts and designs for streetscapes |
| | appraise such concepts in the context of competing requirements. |
| | design, justify and reflect their own solutions for concrete examples. |
| Personal Competence | |
| Social Competence | Students are able to: |
| | discuss intermediate results with each other. |
| | constructively accept feedback on their own work. |
| | provide constructive feedback to others. |
| | |
| Autonomy | Students are able to: |
| | independently complete a written report including drawings following a broadly pre-defined process. |
| | assess the consequences of their proposed solutions. |
| | independently acquire knowledge and apply this to new issues or problem areas. |
| | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Credit points | 6 |
| Course achievement | None |
| Examination | Written elaboration |
| Examination duration and scale | written assignment, designwork during the semester |
| | Civil Engineering: Specialisation Structural Engineering: Elective Compulsory |
| - | Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory |
| | Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory |
| | Civil Engineering: Specialisation Water and Traffic: Elective Compulsory |
| | Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective Compulsory |
| | Water and Environmental Engineering: Specialisation Environment: Elective Compulsory |
| | Water and Environmental Engineering: Specialisation Cities: Compulsory |

| Courses | | | | |
|--|---|------------------------------------|---------------|----------------------|
| Title | Тур | | Hrs/wk | СР |
| Construction Logistics (L1163) | Lect | | 1 | 2 |
| Construction Logistics (L1164) | | tation Section (small) | 1 | 2 |
| Project Development and Managen | | ure ect-/problem-based Learning | 1 | 1 |
| Project Development and Managen | | ect-/problem-based Leanning | T | 1 |
| Module Responsible | - | | | |
| Admission Requirements Recommended Previous | | | | |
| Kecommended Previous | none | | | |
| | After taking part successfully, students have reached the following lea | arning roculto | | |
| Educational Objectives | After taking part successiony, students have reached the following lea | | | |
| Professional Competence | Students con | | | |
| Knowledge | Students can | | | |
| | • give definitions of the main terms of construction logistics and | project development and m | anagement | |
| | name advantages and disadvantages of internal or external co | nstruction logistics | | |
| | • explain characteristics of products, demand and production of | construction objects and the | eir consequer | nces for constructio |
| | specific supply chains | | | |
| | differentiate constructions logistics from other logistics system | S | | |
| Skille | Students can | | | |
| SKIIIS | | | | |
| | carry out project life cycle assessments | | | |
| | apply methods and instruments of construction logistics | | | |
| | apply methods and instruments of project development and ma | anagement | | |
| | apply methods and instruments of conflict management | | | |
| | design supply and waste removal concepts for a construction p | roject | | |
| Personal Competence | | | | |
| Social Competence | Students can | | | |
| boerar competence | | | | |
| | hold presentations in and for groups | | | |
| | apply methods of conflict solving skills in group work and case | studies | | |
| Autonomy | Students can | | | |
| , aconomy | | | | |
| | solve problems by holistic, systemic and flow oriented thinking | | | |
| | improve their creativity, negotiation skills, conflict and crises | s solution skills by applying | methods of | moderation in cas |
| | studies | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | Written elaboration | | | |
| | Two written papers with presentations | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Elective Com | pulsory | | |
| Following Curricula | | | | |
| string curriculu | Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Water and Traffic: Elective Compulso | • | | |
| | International Management and Engineering: Specialisation II. Civil Eng | | orv | |
| | International Management and Engineering: Specialisation II. Logistics | | | |
| | | | | |
| | Logistics, Infrastructure and Mobility: Specialisation Production and Lo | aistics: Elective Compulsory | / | |

| e L1163: Construction | Lecture |
|-----------------------|--|
| Hrs/wk | |
| | |
| CP | |
| | Independent Study Time 46, Study Time in Lecture 14 Prof. Heike Flämig |
| Language | |
| | |
| Cycle Content | The lecture gives deeper insight how important logistics are as a competetive factor for construction projects and which issues are to be adressed. The following toppics are covered: • competetive factor logistics • the concept of systems, planning and coordination of logistics • the concept of systems, planning and coordination of logistics • material, equipment and reverse logistics • IT in construction logistics • elements of the planning model of construction logistics and their connections • flow oriented logistics systems for construction projects • logistics concepts for ready to use construction projects (especially procurement and waste removel logistics) • best practice examples (construction logistics Potsdamer Platz, recent case study of the region) Contents of the lecture are deepened in special exercises. |
| Literature | Flämig, Heike: Produktionslogistik in Stadtregionen. In: Forschungsverbund Ökologische Mobilität (Hrsg.) Forschungsbericht Bo 15.2. Wuppertal 2000. Krauss, Siri: Die Baulogistik in der schlüsselfertigen Ausführung, Bauwerk Verlag GmbH Berlin 2005. Lipsmeier, Klaus: Abfallkennzahlen für Neubauleistungen im Hochbau : Verlag Forum für Abfallwirtschaft und Altlasten, 2004. Schmidt, Norbert: Wettbewerbsfaktor Baulogistik. Neue Wertschöpfungspotenziale in der Baustoffversorgung. In: Klaus, Peter Edition Logistik. Band 6. Deutscher Verkehrs-Verlag. Hamburg 2003. Seemann, Y.F. (2007): Logistikkoordination als Organisationseinheit bei der Bauausführung Wissenschaftsverlag Mainz in Aachen, Aachen. (Mitteilungen aus dem Fachgebiet Baubetrieb und Bauwirtschaft (Hrsg. Kuhne, V.): Heft 20) |

| ourse L1164: Construction Logistics | |
|-------------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Heike Flämig |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L1161: Project Devel | ourse L1161: Project Development and Management | | |
|-----------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Heike Flämig, Dr. Anton Worobei | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Within the lecture, the main aspects of project development and management are tought: Terms and definitions of project management Advantages and disadvantages of different ways of project handling organization, information, coordination and documentation cost and fincance management in projects time- and capacity management in projects specific methods and instruments for successful team work | | |
| Literature | Contents of the lecture are deepened in special exercises. Projektmanagement-Fachmann. Band 1 und Band 2. RKW-Verlag, Eschborn, 2004. | | |

| Course L1162: Project Devel | rse L1162: Project Development and Management | | |
|-----------------------------|---|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Heike Flämig, Dr. Anton Worobei | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | |
|-----------------------------------|---|--|--------------------|---------------------|
| Title | | Тур | Hrs/wk | СР |
| Structural Dynamics (L1202) | | Lecture | 2 | 2 |
| Structural Dynamics (L1203) | | Recitation Section (large) | 2 | 2 |
| Fracture mechanics and fatigue in | steel structures (L0564) | Lecture | 1 | 1 |
| Fracture mechanics and fatigue in | steel structures (L0565) | Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof. Bastian Oesterle | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Knowledge of linear structural analysis | of statically determinate and indeterminate struc | tures; Mechanics | I/II, Mathematics |
| Knowledge | Differential equations I | | | |
| Educational Objectives | After taking part successfully, students h | have reached the following learning results | | |
| Professional Competence | ······ | ······································ | | |
| | After successful completion of this more | dule, the student can explain the basic aspects of | dynamic effects o | on structures and t |
| | respective methods. | | | |
| | | | | |
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| | | | | |
| | | | | |
| Skills | After successful completion of this mo | odule, the students will be able to predict the re | sponse of mater | ial and structures |
| | dynamics loading using the appropriate | computational approaches and methods. | | |
| | | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Students can | | | |
| | | | | |
| | participate in subject-specific and | l interdisciplinary discussions, | | |
| | defend their own work results in f | front of others | | |
| | promote the scientific developme | ent of colleagues | | |
| | Furthermore, they can give and a | ccept professional constructive criticism | | |
| Autonomy | Students are able to gain knowledge of | the subject area from given and other sources and | apply it to new pr | oblems Furthermo |
| Autonomy | | rocess for problems in the area of Structural Analysis | | obierns. Furthernio |
| | | | | |
| Workload in Hours | Independent Study Time 96, Study Time | e in Lecture 84 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 150 min | | | |
| scale | | | | |
| - | Civil Engineering: Specialisation Structur | ral Engineering: Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotech | hnical Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Coastal | Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Water a | and Traffic: Elective Compulsory | | |
| | | | | |
| | Civil Engineering: Specialisation Comput | tational Engineering: Elective Compulsory | | |

| Course L1202: Structural Dy | namics | |
|-----------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Bastian Oesterle | |
| Language | DE | |
| Cycle | SoSe | |
| Content | mechanical background of dynamics harmonic vibrations, damped and undamped free and forced vibrations frequency and time domain modelling aspects principle of d'Alembert systems with multiple degrees of freedom consistent and lumped mass matrices finite elements for dynamics problems impact problems eigenvalue problems and modal analysis direct time integration schemes, transient analyses | |
| Literature | Vorlesungsmanuskript Clough, R.W., Penzien, J.: Dynamics of Structures. 2. Aufl., McGraw-Hill, New York, 1993. | |

| ourse L1203: Structural Dynamics | |
|----------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Bastian Oesterle |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Тур | Lecture |
|-------------------|--|
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Jürgen Priebe |
| Language | DE |
| Cycle | SoSe |
| Content | basics of fatigue stress and fatigue resistance and determination of fatigue strength, |
| | determination and use of S-N-curves and classification of notch effects, |
| | set up of determination of fatigue strength under dynamic load using the accumulation formula by Palmgren-Miner, |
| | set up of determination of fatigue strength in different examples, |
| | basics of construction and design regarding the problem of material fatigue, |
| | basics of linear elastic fracture mechanics under static and dynamic load, |
| | determination of lifetime of steel construction based on linear elastic fracture mechanics in different examples. |
| Literature | Seeßelberg, C.; Kranbahnen - Bemessung und konstruktive Gestaltung; 3. Auflage; Bauwerk-Verlag; Berlin 2009 |
| | • Kuhlmann, Dürr, Günther; Kranbahnen und Betriebsfestigkeit; in Stahlbau Kalender 2003; Verlag Ernst & Sohn; Berlin 2003 |
| | Deutscher Stahlbau-Verband (Hrsg.); Stahlbau Handbuch Band 1 Teil B; 3. Auflage; Stahlbau-Verlagsgesellschaft; Köln 199 |
| | Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993 |
| | DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsree Bemessungsregeln f ür den Hochbau; 1993 |
| | • DIN V ENV 1993-6: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 6: Kranbahnen; 2001 |
| | DIN-Fachbericht 126. Richtlinie zur Anwendung von DIN V ENV 1993-6; Nationales Anwendungsdokument (NAD); Berlin 20 |
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| | 1 |

| Course L0565: Fracture mechanics and fatigue in steel structures | |
|--|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Jürgen Priebe |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Courses | | | | |
|------------------------------------|---|--|----------|----|
| Гitle | | Тур | Hrs/wk | СР |
| Steel Construction Project (L1206) | | Project Seminar | 4 | 6 |
| Module Responsible | Prof. Marcus Rutner | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Steel and Composite Structures | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students | have reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to prepare a part of the | he whole project and explain it to the others. | | |
| Skills | Students can produce sketches and calculations of their part of the project. They are able to adjust their work in reaction | | | |
| | changing conditions resulting from othe | r participants of the project. | | |
| Personal Competence | | | | |
| Social Competence | Students can present their results to ot | her members of the group. | | |
| | They have the ability to work for a broa | d agreement with respect to intergroup depend | dencies. | |
| | They can distribute and process tasks ir | ndependently. | | |
| Autonomy | Students can handle their part of the pr | oject on their own resposibility- | | |
| Workload in Hours | Independent Study Time 124, Study Tin | ne in Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | approx. 15-20 pages (without appendix |) | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Geotec | hnical Engineering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Coasta | Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Structu | ral Engineering: Compulsory | | |
| | Civil Engineering: Specialisation Compu | tational Engineering: Elective Compulsory | | |

| Course L1206: Steel Construction Project | |
|--|---|
| Тур | Project Seminar |
| Hrs/wk | 4 |
| CP | 6 |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Lecturer | Prof. Marcus Rutner |
| Language | DE |
| Cycle | SoSe |
| Content | Design of a big construction project (i.e skyscraper, large bridge, roof of a stadiuim) in small groups |
| Literature | Wird je nach Projekt individuell angegeben. |

| Courses | | | | | |
|---|--|--|-----------------|-------------------|--|
| Title | | Тур | Hrs/wk | СР | |
| Marine Geotechnics (L0548) | | Lecture | 1 | 2 | |
| Marine Geotechnics (L0549) | Undrewlie Engine grieg (11146) | Recitation Section (large) | 2 | 2 | |
| Steel Structures in Foundation and | | Lecture | Z | Z | |
| Module Responsible Admission Requirements | | | | | |
| | Complete modules: Geotechnics I-III, Math | omatics LIII | | | |
| Kecommended Previous Knowledge | complete modules: Geotechnics I-III, Math | | | | |
| Kilowiedge | Courses: Soil laboratory course | | | | |
| Educational Objectives | After taking part successfully, students ha | ve reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | The students get a deeper knowledge of steel and ground engineering as well as constructions knowledge concerning quay wa | | | oncerning quay wa | |
| | Furthermore, the students get all the necessary knowledge to design singular construction elements for sheet pile walls and the | | | | |
| | know how to choose the right construction | elements depending on the influencing conditions | š. | | |
| | Furthermore, the students are able to div | | | | |
| Skills Furthermore, the students are able to dimension sheet pile wall co | | , | | | |
| | suitable construction elements with respect to the influencing conditions, to design all kinds of sheet pile walls (wave sheet pil walls and combined sheet pile walls) and to dimension all construction elements and connections. | | | | |
| | waits and combined sheet pile waits) and t | | 10115. | | |
| Personal Competence | | | | | |
| Social Competence | | | | | |
| Autonomy | Students are able to assess their own stre | ngths and weaknesses and organize their time and | learning manage | ement based on th | |
| 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 | Civil Engineering: Specialisation Geotechn | ical Engineering: Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Structural | Engineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Coastal E | ngineering: Compulsory | | | |
| | Civil Engineering: Specialisation Computat | ional Engineering: Elective Compulsory | | | |
| | | 5 5 7 7 | | | |

| Course L0548: Marine Geotechnics | | |
|----------------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Jürgen Grabe | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Geotechnical investigation an description of the seabed Foundations of Offshore-Constructions cCliff erosion Sea dikes Port structures Flood protection structures | |
| Literature | EAK (2002): Empfehlungen für Küstenschutzbauwerke EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke Poulos H.G. (1988): Marine Geotechnics. Unwin Hyman, London Wagner P. (1990): Meerestechnik: Eine Einführung für Bauingenieure. Ernst & Sohn, Berlin | |

Module Manual M.Sc. "Civil Engineering"

| Course L0549: Marine Geote | irse L0549: Marine Geotechnics | |
|----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Jürgen Grabe | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L1146: Steel Structur | Course L1146: Steel Structures in Foundation and Hydraulic Engineering | |
|------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Frank Feindt | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Design of a sheet pile wall, design of a combined sheet pile wall, piles, walings, connections, fatigue | |
| Literature | EAU 2012, EA-Pfähle, EAB | |

| _ | | | | |
|---|--|--|---|---|
| Courses Title | | Тур | Hrs/wk | СР |
| Port Logistics (L0686) Port Logistics (L1473) | | Lecture Recitation Section (small) | 2 | 3 |
| Module Responsible | Prof. Carlos Jahn | | - | 5 |
| Admission Requirements | | | | |
| Recommended Previous | | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have rea | ached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Th | | | |
| | After completing the module, students can | | | |
| | relevant operator models) and place them explain and evaluate different types technologies, logistic functional areas); analyze common planning tasks (e.g. be suitable approaches (in terms of methods) | of seaport terminals and their specific or orth planning, stowage planning, yard planning | characteristics (in an and in a construction of the seaport terms) at seaport terms | cargo, transhipme erminals and devel |
| Skills | requirements, quay wall length, port acce | eaport terminals; stems for container terminals; to given boundary conditions, e.g. required | | |
| Personal Competence Social Competence | After completing the module, students can | | | |
| | transfer the acquired knowledge to furthe discuss and successfully organize extensi in small groups, document work results in | | nt them to an ap | propriate extent. |
| Autonomy After completing the module, the studen | | ble to | | |
| | independently; | including standards, guidelines and journal elaboration in small groups in due time and | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lec | ture 56 | | |
| Credit points | 6 | | | |
| Course achievement | CompulsoryBonusFormNo15 %Written elaboration | Description | | |
| | Written exam | | | |
| Examination | I | | | |
| Examination Examination duration and | 120 minutes | | | |
| | 120 minutes | | | |
| Examination duration and | | ering: Elective Compulsory | | |
| Examination duration and scale | Civil Engineering: Specialisation Coastal Enginee International Management and Engineering: Spe | ecialisation II. Logistics: Elective Compulsory | | |
| Examination duration and scale Assignment for the | Civil Engineering: Specialisation Coastal Enginee International Management and Engineering: Spe Logistics, Infrastructure and Mobility: Specialisat | cialisation II. Logistics: Elective Compulsory tion Production and Logistics: Elective Compu | - | |
| Examination duration and scale Assignment for the | Civil Engineering: Specialisation Coastal Enginee International Management and Engineering: Spe Logistics, Infrastructure and Mobility: Specialisat Logistics, Infrastructure and Mobility: Specialisat | ecialisation II. Logistics: Elective Compulsory tion Production and Logistics: Elective Compul tion Infrastructure and Mobility: Elective Comp | - | |
| Examination duration and scale Assignment for the | Civil Engineering: Specialisation Coastal Enginee International Management and Engineering: Spe Logistics, Infrastructure and Mobility: Specialisat | ecialisation II. Logistics: Elective Compulsory tion Production and Logistics: Elective Compul tion Infrastructure and Mobility: Elective Comp y Systems: Elective Compulsory | - | |

| Course L0686: Port Logistics | | |
|------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Carlos Jahn | |
| Language | ιΕ | |
| Cycle | SoSe | |
| Content | Port Logistics deals with the planning, control, execution and monitoring of material flows and the associated information flows in the port system and its interfaces to numerous actors inside and outside the port area. The extraordinary role of maritime transport in international trade requires very efficient ports. These must meet numerous requirements in terms of economy, speed, safety and the environment. Against this background, the lecture Port Logistics deals with the planning, control, execution and monitoring of material flows and the associated information flows in the port system and its interfaces to numerous actors inside and outside the port area. The aim of the lecture Port Logistics is to convey an understanding of structures and processes in ports. The focus will be on different types of terminals, their characteristical layouts and the technical equipment used as well as the ongoing digitization and interaction of the players involved. In addition, renowned guest speakers from science and practice will be regularly invited to discuss some lecture-relevant topics from alternative perspectives. The following contents will be conveyed in the lectures: • Instruction of structures and processes in the port • Planning, control, implementation and monitoring of material and information flows in the port • Fundamentals of different terminals, characteristical layouts and the technical equipment used • Handling of current issues in port logistics | |
| Literature | Alderton, Patrick (2013). Port Management and Operations. Biebig, Peter and Althof, Wolfgang and Wagener, Norbert (2017). Seeverkehrswirtschaft: Kompendium. Brinkmann, Birgitt. Seehäfen: Planung und Entwurf. Berlin Heidelberg: Springer-Verlag, 2005. Büter, Clemens (2013). Außenhandel: Grundlagen internationaler Handelsbeziehungen. Gleissner, Harald and Femerling, J. Christian (2012). Logistik: Grundlagen, Übungen, Fallbeispiele. Jahn, Carlos; Saxe, Sebastian (Hg.). Digitalization of Seaports - Visions of the Future, Stuttgart: Fraunhofer Verlag, 2017. Kummer, Sebastian (2019). Einführung in die Verkehrswirtschaft Lun, Y.H.V. and Lai, KH. and Cheng, T.C.E. (2010). Shipping and Logistics Management. Woitschützke, Claus-Peter (2013). Verkehrsgeografie. | |

| Course L1473: Port Logistics | |
|------------------------------|--|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Carlos Jahn |
| Language | DE |
| Cycle | SoSe |
| Content | The content of the exercise is the independent preparation of a scientific paper plus an accompanying presentation on a current topic of port logistics. The paper deals with current topics of port logistics. For example, the future challenges in sustainability and productivity of ports, the digital transformation of terminals and ports or the introduction of new regulations by the International Maritime Organization regarding the verified gross weight of containers. Due to the international orientation of the event, the paper is to be prepared in English. |
| Literature | Alderton, Patrick (2013). Port Management and Operations. Biebig, Peter and Althof, Wolfgang and Wagener, Norbert (2017). Seeverkehrswirtschaft: Kompendium. Brinkmann, Birgitt. Seehäfen: Planung und Entwurf. (2005) Berlin Heidelberg: Springer-Verlag. Büter, Clemens (2013). Außenhandel: Grundlagen internationaler Handelsbeziehungen. Gleissner, Harald and Femerling, J. Christian (2012). Logistik: Grundlagen, Übungen, Fallbeispiele. Jahn, Carlos; Saxe, Sebastian (Hg.) (2017) Digitalization of Seaports - Visions of the Future, Stuttgart: Fraunhofer Verlag. Kummer, Sebastian (2019). Einführung in die Verkehrswirtschaft Lun, Y.H.V. and Lai, KH. and Cheng, T.C.E. (2010). Shipping and Logistics Management. Woitschützke, Claus-Peter (2013). Verkehrsgeografie. |

| Courses | | | | |
|--|---|---|------------------|---------------------|
| | | T | llue (colo | <u></u> |
| Title Water and Environment (L2754) | | Typ Project-/problem-based Learning | Hrs/wk 3 | СР 3 |
| Water and Environment (L2753) | | Lecture | 3 | 3 |
| Module Responsible | Prof. Nima Shokri | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Basic knowledge in water and environmental research, I | Hydrology | | |
| Educational Objectives | After taking part successfully, students have reached th | e following learning results | | |
| Professional Competence | | | | |
| Knowledge | Common research tools and techniques together with the fundamental knowledge relevant to multi-scale and multi-phas challenges present in water and environmental research will be discussed in this module. Both theory and application will b considered. | | | |
| Skills | In addition to the fundamental knowledge, the students will be exposed to several analytical, experimental and numerical too and techniques relevant to water and environmental research at different scales. This will provide the students with an exceller opportunity to improve their skills on multiple fronts which will be useful in their future career. | | | |
| Personal Competence | | | | |
| Social Competence | Developing teamwork and problem solving skills through | n Research-Based Teaching approaches v | will be at the c | ore of this module |
| Autonomy | The students will be involved in writing individual re willingness to work independently and responsibly. | ports and presentation. This will contri | bute to the s | students' ability a |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Subject theoretical and practical work | | | |
| Examination duration and | Report and Presentation | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Engineering: Ele | ective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Water and Traffic: Elect | ive Compulsory | | |
| | Environmental Engineering: Specialisation Environment | and Climate: Elective Compulsory | | |
| | Water and Environmental Engineering: Specialisation Ci | ties: Elective Compulsory | | |
| | Water and Environmental Engineering: Specialisation W | ater: Elective Compulsory | | |
| | Water and Environmental Engineering: Specialisation Er | | | |

| Course L2754: Water and En | Course L2754: Water and Environment | |
|----------------------------|---|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 3 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | |
| Lecturer | Dr. Salome Shokri-Kuehni | |
| Language | EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L2753: Water and En | vironment |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Prof. Nima Shokri |
| Language | EN |
| Cycle | SoSe |
| Content | Research based learning: The students will be engaged in active research focused on water and environmental related challenges. |
| | The required knowledge and tools will be discussed during the semester. |
| Literature | NA |

| Courses | | | | |
|----------------------------|--|---|--------------------|-------------------|
| Title | | Тур | Hrs/wk | СР |
| Maritime Transport (L0063) | | Lecture | 2 2 | 3 3 |
| Maritime Transport (L0064) | | Recitation Section (small) | Z | 3 |
| Module Responsible | | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | After taking part successfully, students have reached | the following learning results | | |
| | After taking part successfully, students have reached | the following learning results | | |
| Professional Competence | The students are able to | | | |
| Knowledge | The students are able to | | | |
| | present the actors involved in the maritime tra | nsport chain with regard to their typical | tasks; | |
| | name common cargo types in shipping and cla | ssify cargo to the corresponding categor | ies; | |
| | explain operating forms in maritime shipping, t | ransport options and management in tra | ansport networks | ; |
| | weigh the advantages and disadvantages of th | e various modes of hinterland transport | and apply them i | n practice; |
| | estimate the potential of digitisation in maritim | e shipping. | | |
| | | | | |
| | | | | |
| Skills | The students are able to | | | |
| | determine the mode of transport, actors and full | nctions of the actors in the maritime su | oply chain; | |
| | identify possible cost drivers in a transport cha | | | on; |
| | record, map and systematically analyse mat | | | |
| | problems and recommend solutions; | | - | |
| | perform risk assessments of human disruptions | to the supply chain; | | |
| | analyse accidents in the field of maritime logistication | tics and evaluating their relevance in ev | eryday life; | |
| | deal with current research topics in the field of | maritime logistics in a differentiated wa | у; | |
| | plan the deployment of a fleet based on scenarios; | | | |
| | apply different process modelling methods in a | hitherto unknown field of activity and to | o work out the re | spective advantag |
| Personal Competence | | | | |
| | The students are able to | | | |
| Social competence | | | | |
| | discuss and organise extensive work packages | in groups; | | |
| | document and present the elaborated results. | | | |
| Autonomy | The students are capable to | | | |
| Autonomy | | | | |
| | research and select technical literature, includi | ng standards and guidelines; | | |
| | submit own shares in an extensive written elab | oration in small groups in due time. | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 5 | 56 | | |
| Credit points | 6 | | | |
| Course achievement | | scription | | |
| | No 15 % Subject theoretical and Te | ilnahme an einem Planspiel und anschli | eßende schriftlich | ne Ausarbeitung |
| | practical work | | | |
| Examination | Written exam | | | |
| Examination duration and | | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Engineering: | Elective Compulsory | | |
| Following Curricula | International Management and Engineering: Specialis | | | |
| | Logistics, Infrastructure and Mobility: Specialisation P | • • • | sory | |
| | Logistics, Infrastructure and Mobility: Specialisation Ir | | | |
| | Renewable Energies: Specialisation Wind Energy Syst | | - | |
| | Theoretical Mechanical Engineering: Specialisation Ma | | , | |

| Course L0063: Maritime Tran | isport |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Carlos Jahn |
| Language | DE |
| Cycle | SoSe |
| | The general tasks of maritime logistics include the planning, design, implementation and control of material and information flows in the logistics chain ship - port - hinterland. The aim of the course is to provide students with knowledge of maritime transport and the actors involved in the maritime transport chain. Typical problem areas and tasks will be dealt with, taking into account the economic development. Thus, classical problems as well as current developments and trends in the field of maritime logistics are considered. In the lecture, the components of the maritime logistics chain and the actors involved will be examined and risk assessments of human disturbances on the supply chain will be developed. In addition, students learn to estimate the potential of digitisation in maritime shipping, especially with regard to the monitoring of ships. In addition, students are able to design operational planning for fleets of container or tramp vessels. Further content of the lecture is the different modes of transport in the hinterland, which students can evaluate after completion of the course regarding their advantages and disadvantages. |
| Literature | Clausen, Uwe and Geiger, Christiane. Verkehrs- und Transportlogistik. Berlin Heidelberg: Springer-Verlag, 2013. Schönknecht, Axel. Maritime Containerlogistik: Leistungsvergleich von Containerschiffen in intermodalen Transportketten. Berlin Heidelberg: Springer-Verlag, 2009. Rodrigue, Jean-Paul. Geography of Transport Systems. London New York: Routledge, 2020. Stopford, Martin. Maritime Economics Routledge, 2009. |

| Course L0064: Maritime Tran | isport |
|-----------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Carlos Jahn |
| Language | DE |
| Cycle | SoSe |
| Content | The exercise lesson bases on the haptic management game MARITIME. MARITIME focuses on providing knowledge about structures and processes in a maritime transport network. Furthermore, the management game systematically provides process management methodology and also promotes personal skills of the participants. |
| Literature | Brinkmann, Birgitt. Seehäfen: Planung und Entwurf. Berlin Heidelberg: Springer-Verlag, 2005. Koch Susanne. Methoden des Prozessmanagements. In: Einführung in das Management von Geschäftsprozessen. Springer, Berlin, Heidelberg, 2011. Liebetruth, Thomas. Prozessmanagement in Einkauf und Logistik, Springer Gabler: Wiesbaden, 2020. Schönknecht, Axel. Maritime Containerlogistik: Leistungsvergleich von Containerschiffen in intermodalen Transportketten. Berlin Heidelberg: Springer-Verlag, 2009. Stopford, Martin. Maritime Economics Routledge, 2009 |

| C | | | | |
|--|---|--|-------------------|--------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Smart Monitoring (L2762) Smart Monitoring (L2763) | | Integrated Lecture Recitation Section (small) | 2 | 2 4 |
| Module Responsible | Prof. Kay Smarsly | | - | · |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge or interest in object-oriented modeli | ng programming and sensor technologic | nies are helpful | Interest in mor |
| Knowledge | research and teaching areas, such as Internet of Thir | | | |
| J. | skills of scientific working, are required. Basic knowled | | | |
| | | | | |
| | After taking part successfully, students have reached t | ne following learning results | | |
| Professional Competence | The students will become familiar with the principle | and practices of smart monitoring | The students wil | l ha abla ta da |
| Kilowiedye | The students will become familiar with the principle decentralized smart systems to be applied for con | | | |
| | environment. In addition, the students will learn to des | | | |
| | analysis techniques, modern software design concepts | | | |
| | | | | |
| | also part of this module, which will be conducted throughout the semester and will contribute to the grade. In small groups, the students will design smart monitoring systems that integrate a number of "intelligent" sensors to be implemented by the student | | | |
| | Specific focus will be put on the application of machine learning techniques. The smart monitoring systems will be mounted of | | | |
| | real-world (built or natural) systems, such as bridges o | 5 1 | 5 5 | |
| | every group will be documented in a paper. All student | | | |
| | system in the annual "Smart Monitoring" competition. | The written papers and oral examinatio | ns form the final | grades. The mo |
| | will be taught in English. Limited enrollment. | | | |
| | | | | |
| Skills | The students will gain insights into operating state-of- | | | |
| | processes relevant to engineering, such as environmental, structural, or comfort monitoring. The students will be capable | | | |
| | devising monitoring strategies of physical processes as part of group projects, tailored to their knowledge backgrounds, and t implement the strategies in smart wireless sensor nodes, using embedded computing and programming. Finally, the students w | | | |
| | | | ogramming. Fina | lly, the students |
| | be able to document the findings of their projects in sh | or reports. | | |
| Personal Competence | | | | |
| Social Competence | The students will be able to work in groups, share par | ts of the work for their projects, and de | evelop communic | ation skills, towa |
| | achieving the common project goals. | | | |
| Διιτοποπγ | The students will be able to gain a solid basis on app | proaching and solving problems in eng | ineering as well | as on documen |
| hatohomy | results, through their involvement in their monitoring of | | incernig, us wen | us on usedinen |
| | | | | |
| | Independent Study Time 124, Study Time in Lecture 56 | 5 | | |
| Credit points Course achievement | | | | |
| | Written elaboration | | | |
| | 10 pages of work with 15-minute oral presentation | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Water and Traffic: Elec | tive Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineer | ing: Elective Compulsory | | |
| | Civil Engineering: Specialisation Coastal Engineering: E | lective Compulsory | | |
| | Civil Engineering: Specialisation Structural Engineering | : Elective Compulsory | | |
| | Computer Science: Specialisation II: Intelligence Engine | eering: Elective Compulsory | | |
| | Environmental Engineering: Specialisation Energy and | Resources: Elective Compulsory | | |
| | Environmental Engineering: Specialisation Environmen | t and Climate: Elective Compulsory | | |
| | Environmental Engineering: Specialisation Water Quali | ty and Water Engineering: Elective Com | pulsory | |
| | Mechatronics: Technical Complementary Course: Elect | ve Compulsory | | |
| | Mechatronics: Core Qualification: Elective Compulsory | | | |
| | Theoretical Mechanical Engineering: Specialisation Rob | | ompulsory | |
| | Water and Environmental Engineering: Specialisation C | | | |
| | Water and Environmental Engineering: Specialisation E | nvironment: Elective Compulsory | | |
| | Water and Environmental Engineering: Specialisation V | | | |

| Course L2762: Smart Monito | ring |
|----------------------------|--|
| Тур | Integrated Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Kay Smarsly |
| Language | EN |
| Cycle | SoSe |
| Content | In this course, principles of smart monitoring will be taught, focusing on modern concepts of data acquisition, data storage, and data analysis. Also, fundamentals of intelligent sensors and embedded computing will be illuminated. Autonomous software and decentralized data processing are further crucial parts of the course, including concepts of the Internet of Things, Industry 4.0 and cyber-physical systems. Furthermore, measuring principles, data acquisition systems, data management and data analysis algorithms will be discussed. Besides the theoretical background, numerous practical examples will be shown to demonstrate how smart monitoring may advantageously be used for assessing the condition of systems in the built or natural environment. |
| Literature | The course contents couples different fields, such as signal processing, sensing technologies, data analytics, environmental engineering, civil engineering, artificial intelligence, database systems, and many more. The basics will be taught in this course. However, specific literature that covers all these topics does not exist. Instead, literature will be referenced in the lectures, all of which are papers that are freely available online. |

| Course L2763: Smart Monito | ring |
|----------------------------|---|
| | Recitation Section (small) |
| Hrs/wk | |
| СР | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. Kay Smarsly |
| Language | EN |
| Cycle | SoSe |
| | The contents of the exercises are based on the lecture contents. In addition to the exercises, project work will be conducted throughout the semester, which will consume the majority of the workload. As part of the project work, students will design smart monitoring systems that will be tested in the laboratory or in the field. As mentioned in the module description, the students will participate in the "Smart Monitoring" competition, hosted annually by the Institute of Digital and Autonomous Construction. Students are encouraged to contribute their own ideas. The tools required to implement the smart monitoring systems will be taught in the group exercises as well as through external sources, such as video tutorials and literature. The course contents couples different fields, such as signal processing, sensing technologies, data analytics, environmental engineering, civil engineering, artificial intelligence, database systems, and many more. The basics will be taught in this course. |
| | However, specific literature that covers all these topics does not exist. Instead, literature will be referenced in the lectures, all of which are papers that are freely available online. |

| Module M1845: Thin- | walled structures | | | |
|--------------------------------|---|---|--------------------|---------------------|
| | | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Thin-walled structures (L1199) | | Lecture | 2 | 3 |
| Thin-walled structures (L3045) | | Recitation Section (large) | 2 | 3 |
| Module Responsible | Prof. Bastian Oesterle | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Structural Analysis I | | | |
| Knowledge | Structural Analysis I Structural Analysis II | | | |
| | Finite Element Methods | | | |
| | • Thite Element Methods | | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After successful completion of this module, | the students can express the basic aspects of | the load-carryin | g behaviour of thi |
| | walled structures. | | | |
| Skille | s After successful completion of this module, the students will be able to predict load-carrying behaviour of thin-walled structu | | | |
| SKIIIS | | | y benaviour of t | inin-waned structur |
| | using appropriate analytical and coputational | methods. | | |
| Personal Competence | | | | |
| Social Competence | Students can | | | |
| | participate in subject-specific and inter | disciplinary discussions | | |
| | defend their own work results in front of | | | |
| | promote the scientific development of | | | |
| | Furthermore, they can give and accept | • | | |
| | · ···································· | | | |
| Autonomy | Students are able to gain knowledge of the s | ubject area from given and other sources and ap | oply it to new pro | blems. Furthermor |
| | they are able to structure the solution proces | s for problems in the area of modelling and analy | sis of thin-walle | d structures. |
| Workload in Hours | Independent Study Time 124, Study Time in I | Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Engin | neering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical | Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Computation | al Engineering: Compulsory | | |
| | Civil Engineering: Specialisation Structural En | gineering: Elective Compulsory | | |
| | Theoretical Mechanical Engineering: Specialis | ation Simulation Technology: Elective Compulso | ry | |

| Тур | Lecture |
|------------|--|
| Hrs/wk | |
| CP | |
| | Independent Study Time 62, Study Time in Lecture 28 |
| | Prof. Bastian Oesterle |
| | |
| Language | |
| Cycle | |
| Content | Plates loaded in-plane |
| | Governing equations (equilibrium, kinematics, constitutive law) |
| | Differential equation |
| | Airy stress function |
| | Plane stress / plane strain |
| | Structural behaviour of plates loaded in-plane |
| | • finite elements for plates loaded in-plane, modelling apsects, interpretation and critical assessment of results |
| | Plates in bending |
| | Governing equations (equilibrium, kinematics, constitutive law) |
| | Differential equation |
| | Navier solution / Fourier series expansion |
| | Approximation procedures |
| | Circular and rectangular plates |
| | Structural behaviour of plates in bending |
| | • finite elements for plates in bending, modelling apsects, interpretation and critical assessment of results |
| | Shells |
| | |
| | Phenomenona of the structural behaviour of shells |
| | Membrane and bending theory Fourilibrium equations of shalls of roughtion |
| | Equilibrium equations of shells of revolution Stress resultants and deformations of the spherical shell, the half spherical shell, and the cylindrical shell |
| | Stress resolutions and deformations of the spherical shell, the man spherical shell, and the cylindrical shell finite elements for shells |
| | Stability problems (overview) |
| | |
| | Plate buckling |
| | Shell buckling |
| | |
| Literature | |
| | Vorlesungsmanuskript Deservice (1995): Machanik das Elijahartes suurks. Missian Deservice Missiandes |
| | Basar, Y.: Krätzig, W.B. (1985): Mechanik der Flächentragwerke. Vieweg-Verlag, Braunschweig, Wiesbaden Giderage K. (1962): Flächentragwerke. Geringen Verlag, Wiese 1962, www.ständerter Neckdewelt 1986 |
| | Girkmann, K. (1963): Flächentragwerke, Springer Verlag, Wien, 1963, unveränderter Nachdruck 1986 Zischiewing, O.G. (1977): The Sicilia Flagment Mathed in Family Logical McGraw Hill Logical |
| | • Zienkiewicz, O.C. (1977): The Finite Element Method in Enginieering Science. McGraw-Hill, London |
| | |

| Course L3045: Thin-walled st | ourse L3045: Thin-walled structures | | |
|------------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| CP | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Bastian Oesterle | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Module M0858: Coast | tal Hydraulic Engineering I | | | |
|------------------------------------|--|--|-------------------|----------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Basics of Coastal Engineering (L08 | | Lecture | 3 | 4 |
| Basics of Coastal Engineering (L14 | | Project-/problem-based Learnin | g 1 | 2 |
| Module Responsible | Prof. Peter Fröhle | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basics of hydraulic engineering, hydrolog | y and hydromechanics | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students ha | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are able to define and expla | ain the basic concepts of coastal engineering and por | t engineering. Tl | hey are able to app |
| | the concepts to selected practical proble | ms of coastal engineering. Students can define and | determine the b | basics for design a |
| | dimensioning of coastal engineering cons | tructions. | | |
| Skills | The students are canable to apply basic d | design approaches to selected and pre-defined desigr | tasks in coasta | Lengineering |
| SKIIIS | The students are capable to apply basic o | action approaches to selected and pre-defined design | | rengineering. |
| Personal Competence | | | | |
| Social Competence | The students are able to deploy their ga | ined knowledge in applied problems such as the de | sign of coastal p | protection structure |
| | Additionaly, they will be able to work in te | eam with engineers of other disciplines, for instance of | designing of coas | stal breakwaters. |
| Autonomy | The students will be able to independently | y extend their knowledge and applyit to new problem | 15. | |
| 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 | The duration of the examination is 2 ho | ours. The examination includes tasks with respect | to the general u | understanding of th |
| scale | lecture contents and calculations tasks. | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal E | Engineering: Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechr | nical Engineering: Compulsory | | |
| | Civil Engineering: Specialisation Structura | al Engineering: Elective Compulsory | | |
| | Environmental Engineering: Specialisation | n Environment and Climate: Elective Compulsory | | |
| | Environmental Engineering: Specialisation | n Water Quality and Water Engineering: Elective Com | pulsory | |
| | International Management and Engineering | ng: Specialisation II. Civil Engineering: Elective Comp | ulsory | |
| | Water and Environmental Engineering: Sp | pecialisation Environment: Elective Compulsory | | |
| | Water and Environmental Engineering: Sp | pecialisation Water: Elective Compulsory | | |

| Course L0807: Basics of Coastal Engineering | | |
|---|--|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| CP | 4 | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | |
| Lecturer | Prof. Peter Fröhle | |
| Language | EN | |
| Cycle | SoSe | |
| Content | Basics of planning and design Water levels Currents Waves Ice Planning and Design in Coastal Engineering Functional and constructional design Determination of design parameters Design-approaches Filter Rubble mound constructions | |
| Literature | Piles Vertical constructions Coastal Engineering Manual, CEM Vorlesungsumdruck | |

| Course L1413: Basics of Coas | irse L1413: Basics of Coastal Engineering | | |
|------------------------------|---|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 1 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Prof. Peter Fröhle | | |
| Language | EN | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | |
|---|--|---|---------------------------|--------------------|
| | | Turn | Hun bulk | CD |
| Title Offshore Geotechnical Engineering | (10067) | Typ Lecture | Hrs/wk 1 | CP 1 |
| Hydro Power Use (L0013) | (20007) | Lecture | 1 | 1 |
| Wind Turbine Plants (L0011) | | Lecture | 2 | 3 |
| Nind Energy Use - Focus Offshore | L0012) | Lecture | 1 | 1 |
| Module Responsible | Dr. Marvin Scherzinger | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Module: Technical Thermodynamics I, | | | |
| Knowledge | Module: Technical Thermodynamics II, | | | |
| | Module: Technical Thermodynamics II, | | | |
| | Module: Fundamentals of Fluid Mechanics | | | |
| Educational Objectives | After taking part successfully, students have read | ched the following learning results | | |
| Professional Competence | | | | |
| Knowledge | By ending this module students can explain in | detail knowledge of wind turbines w | vith a particular focus o | f wind energy us |
| | offshore conditions and can critical comment the | ese aspects in consideration of curre | nt developments. Furthe | rmore, they are a |
| | to describe fundamentally the use of water powe | er to generate electricity. The studen | ts reproduce and explair | n the basic proced |
| | in the implementation of renewable energy proje | ects in countries outside Europe. | | |
| | Through active discussions of various topics w | ithin the seminar of the module. st | udents improve their un | derstanding and |
| | application of the theoretical background and are | | | |
| | | · · · · · · · · · · · · · · · · · · · | | |
| Skills | s Students are able to apply the acquired theoretical foundations on exemplary water or wind power systems and evaluate a | | | |
| | assess technically the resulting relationships in | | | |
| | compare critically the special procedure for the i | | | tside Europe with |
| | in principle applied approach in Europe and can a | apply this procedure on exemplary th | eoretical projects. | |
| Personal Competence | | | | |
| Social Competence | Students can discuss scientific tasks subjet-spec | ificly and multidisciplinary within a s | eminar. | |
| A 1 1 1 1 1 | | | | |
| Autonomy | V Students can independently exploit sources in the context of the emphasis of the lecture material to clear the contents of the lecture and the context of the subject and the sub | | | |
| | lecture and to acquire the particular knowledge a | about the subject area. | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lect | ture 70 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 180 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engine | eering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical En | gineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Coastal Engineer | ring: Elective Compulsory | | |
| | International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory | | | |
| | International Management and Engineering: Specialisation II. Renewable Energy: Elective Compulsory | | | |
| | Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory | | | |
| | Product Development, Materials and Production: | | | |
| | Product Development, Materials and Production: | • | mpulsory | |
| | Renewable Energies: Core Qualification: Compulsory | | | |
| | Theoretical Mechanical Engineering: Specialisatio | | | |
| | Process Engineering: Specialisation Environment | | pulsory | |
| | Water and Environmental Engineering: Specialisa | ation Cities: Elective Compulsory | | |
| | | | | |
| | Water and Environmental Engineering: Specialise Water and Environmental Engineering: Specialise Water and Environmental Engineering: Specialise | ation Environment: Elective Compulso | ory | |

| Course L0067: Offshore Geot | technical Engineering | | |
|-----------------------------|--|--|--|
| Тур | ecture | | |
| Hrs/wk | | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Dr. Jan Dührkop | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Overview and Introduction Offshore Geotechnics Introduction to Soil Mechanics Offshore soil investigation Focus on cyclical effects Geotechnical design of offshore foundations Monopiles Jackets Heavyweight foundations Geotechnical preliminary exploration for the use of lift boats and platforms | | |
| Literature | Randolph, M. and Gourvenec, S (2011): Offshore Geotechnical Engineering. Spon Press. Poulos H.G. (1988): Marine Geotechnics. Unwin Hyman, London BSH-Standard Baugrunderkundung für Offshore-Windenergieparks Lesny K. (2010): Foundations for Offshore Wind Turbines. VGE Verlag, Essen. EA-Pfähle (2012): Empfehlungen des Arbeitskreises Pfähle der DGGT. Ernst & Sohn, Berlin. | | |

| Course L0013: Hydro Power | Use |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Stefan Achleitner |
| Language | DE |
| Cycle | SoSe |
| Content | Introduction, importance of water power in the national and global context Physical basics: Bernoulli's equation, usable height of fall, hydrological measures, loss mechanisms, efficiencies Classification of Hydropower: Flow and Storage hydropower, low and high pressure systems Construction of hydroelectric power plants: description of the individual components and their technical system interaction Structural engineering components; representation of dams, weirs, dams, power houses, computer systems, etc. Energy Technical Components: Illustration of the different types of hydraulic machinery, generators and grid connection Hydropower and the Environment Examples from practice |
| Literature | Schröder, W.; Euler, G.; Schneider, K.: Grundlagen des Wasserbaus; Werner, Düsseldorf, 1999, 4. Auflage Quaschning, V.: Regenerative Energiesysteme: Technologie - Berechnung - Simulation; Carl Hanser, München, 2011, 7. Auflage Giesecke, J.; Heimerl, S.; Mosony, E.: Wasserkraftanlagen - Planung, Bau und Betrieb; Springer, Berlin, Heidelberg, 2009, 5. Auflage von König, F.; Jehle, C.: Bau von Wasserkraftanlagen - Praxisbezogene Planungsunterlagen; C. F. Müller, Heidelberg, 2005, 4. Auflage Strobl, T.; Zunic, F.: Wasserbau: Aktuelle Grundlagen - Neue Entwicklungen; Springer, Berlin, Heidelberg, 2006 |

| Course L0011: Wind Turbine | Plants |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Dr. Rudolf Zellermann |
| Language | DE |
| Cycle | SoSe |
| Content | Historical development Wind: origins, geographic and temporal distribution, locations Power coefficient, rotor thrust Aerodynamics of the rotor Operating performance Power limitation, partial load, pitch and stall control Plant selection, yield prediction, economy Excursion |
| Literature | Gasch, R., Windkraftanlagen, 4. Auflage, Teubner-Verlag, 2005 |

| Course L0012: Wind Energy | Use - Focus Offshore |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Martin Skiba |
| Language | DE |
| Cycle | SoSe |
| Content | Introduction, importance of offshore wind power generation, Specific requirements for offshore engineering Physical fundamentals for utilization of wind energy Design and operation of offshore wind turbines, presentation of different concepts of offshore wind turbines, representation of the individual system components and their system-technical relationships Foundation engineering, offshore site investigation, presentation of different concepts of offshore foundation structures, planning and fabrication of foundation structures Electrical infrastructure of an offshore wind farm, Inner Park cabling, offshore substation, grid connection Installation of offshore wind farms, installation techniques and auxiliary devices, construction logistics Development and planning of offshore wind farms Operation and optimization of offshore wind farms Day excursion |
| Literature | Gasch, R.; Twele, J.: Windkraftanlagen - Grundlagen, Entwurf, Planung und Betrieb; Vieweg + Teubner, Stuttgart, 2007, 7. Auflage Molly, J. P.: Windenergie - Theorie, Anwendung, Messung; C. F. Müller, Heidel-berg, 1997, 3. Auflage Hau, E.: Windkraftanlagen; Springer, Berlin, Heidelberg, 2008, 4.Auflage Heier, S.: Windkraftanlagen - Systemauslegung, Integration und Regelung; Vieweg + Teubner, Stuttgart, 2009, 5. Auflage Jarass, L.; Obermair, G.M.; Voigt, W.: Windenergie: Zuverlässige Integration in die Energieversorgung; Springer, Berlin, Heidelberg, 2009, 2. Auflage |

| Courses | | | | |
|-----------------------------------|---|---|------------------------|---------------------|
| Title | | Тур | Hrs/wk | СР |
| Water Protection and Wastewater I | - | Lecture | 3 | 3 |
| Water Protection and Wastewater I | - | Project Seminar | 3 | 3 |
| Module Responsible | | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge in water management; | | | |
| Knowledge | Good knowledge in urban drainage; | | | |
| | Good knowledge of wastewater treatme | nt techniques; | | |
| | Good knowledge of pollutants (e.g. COD | , BOD, TS, N, P) and their properties; | | |
| Educational Objectives | After taking part successfully, students have re | pached the following learning results | | |
| Professional Competence | Arter taking part successiony, students have re | | | |
| • | The students can describe the basic principles | of the regulatory framework related to th | e international and Eu | Iropean water secto |
| | They can explain limnological processes, sub | | | |
| | problems related to water protection, such as | | | |
| | solutions, remediation measures as well as cor | ceptual approaches. | | |
| Cl://- | | | least sentent. Then | |
| SKIIIS | Students can accurately assess current proble actions to contribute to the planning of tom | | | |
| | administrative and legislative solutions to solve | | they can suggest a | ppropriate technica |
| | administrative and regislative solutions to solve | e triese problems. | | |
| | | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | The students can work together in internationa | l groups. | | |
| | | | | |
| | | | | |
| | | | | |
| Autonomv | Students are able to organize their work flow | to prepare presentations and discussions | . They can acquire ap | propriate knowledg |
| | by making enquiries independently. | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lec | ture 84 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | | | | |
| | Term paper plus presentation | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Eng | ineering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical I | • • • | | |
| - | Civil Engineering: Specialisation Coastal Engine | eering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Water and Tra | ffic: Elective Compulsory | | |
| | Environmental Engineering: Specialisation Wat | er Quality and Water Engineering: Elective | e Compulsory | |
| | International Management and Engineering: Sp | pecialisation II. Civil Engineering: Elective | Compulsory | |
| | Water and Environmental Engineering: Special | isation Cities: Elective Compulsory | | |
| | Water and Environmental Engineering: Special | isation Water: Elective Compulsory | | |
| | Water and Environmental Engineering: Special | isation Environment: Compulsory | | |

| Course L0226: Water Protect | tion and Wastewater Management |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Prof. Ralf Otterpohl |
| Language | EN |
| Cycle | WiSe |
| Content | The lecture focusses on: Regulatory Framework (e.g. WFD) Main instruments for the water management and protection In depth knowledge of relevant measures of water pollution control Urban drainage, treatment options in different regions on the world Rainwater management, improved management of heavy rainfalls, downpours, rainwater harvesting, rainwater infiltration Case Studies and Field Trips |
| Literature | The literature listed below is available in the library of the TUHH. Water and wastewater technology Hammer, M. J. 1., & . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International. Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011) New York, NY: McGraw-Hill. Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ. |

| Course L2008: Water Protection and Wastewater Management | |
|--|---|
| Тур | Project Seminar |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Prof. Ralf Otterpohl |
| Language | EN |
| Cycle | WiSe |
| Content | |
| Literature | |

| Courses | | | | |
|--|--|--|------------------|---------------------|
| Title | | Тур | Hrs/wk | СР |
| Examination of Materials, Structura | - | Lecture | 3 | 4 |
| Examination of Materials, Structura | | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Frank Schmidt-Döhl | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge about building materials or m | aterial science, for example by the mod | ule Building Ma | terials and Buildin |
| Knowledge | Chemistry. | | | |
| Educational Objectives | After taking part successfully, students have reach | ed the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are able to describe the rules for tra- methods for the testing of building material proper testing methods. | | | |
| Skills | The students are able to responsibly discover the r They are able to chose suitable methods for the te the examination of the structural conditions of buil are able to describe an examination in form of a te | sting and inspection of construction produc dings. They are able to conclude from sym | ts, the examina | ÷ |
| Personal Competence Social Competence | The students can describe the different roles of m framework of material testing. They can describe t | • • | - | on bodies within th |
| Autonomy | | | | stansive field |
| | Independent Study Time 124, Study Time in Lectur | | cuge of a very c | Atensive neid. |
| Credit points | | | | |
| Course achievement | | | | |
| | Written exam | | | |
| Examination duration and | | | | |
| scale | | | | |
| | Civil Engineering: Specialisation Structural Enginee | ring: Elective Compulsory | | |
| Following Curricula | | | | |
| J | Civil Engineering: Specialisation Coastal Engineering | | | |
| | Civil Engineering: Specialisation Water and Traffic: | | | |
| | International Management and Engineering: Specia | | ulsory | |
| | Materials Science and Engineering: Specialisation E | | - | |
| | Materials Science: Specialisation Engineering Mate | rials: Elective Compulsory | | |

| Course L0260: Examination of Materials, Structural Condition and Damages | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| СР | 4 | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | |
| Lecturer | Prof. Frank Schmidt-Döhl | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Materials testing and marking process of construction products, testing methods for building materials and structures, testing | |
| | reports and expert opinions, describing the condition of a structure, from symptons to the cause of damages | |
| Literature | Frank Schmidt-Döhl: Materialprüfung im Bauwesen. Fraunhofer irb-Verlag, Stuttgart, 2013. | |

| Course L0261: Examination of Materials, Structural Condition and Damages | | |
|--|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Frank Schmidt-Döhl | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | | | |
|---|---|---|--|---|--------------------|--------------------|
| Гitle | | | Тур | | Hrs/wk | СР |
| Concrete Structures (L0579) | | | Seminar | | 1 | 1 |
| Structural Concrete Members (L05 | 77) | | Lecture | | 2 | 3 |
| Structural Concrete Members (L05 | 78) | | Recitation | n Section (large) | 2 | 2 |
| Module Responsible | NN | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Recommended Previous Basics of structural analysis, conception and dimensioning of structural concrete | | | | | |
| Knowledge | | | | | | |
| | Modules: Reinforced | d Concrete Structures I | +II, Structural Analysis I+II, Mec | hanics I+II | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Educational Objectives | After taking part su | ccessfully students ha | ve reached the following learnin | a results | | |
| Professional Competence | The taking part sa | ceessiany, stadents na | ve rederied the following learnin | gresults | | |
| | The students broad | on their skills in struct | ral engineering especially in th | e field of buildings | (houses roofs h | alls) They dispose |
| Knowledge | The students broaden their skills in structural engineering, especially in the field of buildings (houses, roofs, halls). They dispose the knowledge for the conception and design of concrete buildings and structural members that are often used. | | | | | |
| | the knowledge for th | ne conception and des | ight of concrete buildings and st | | fat are often aset | |
| Skills | The students are ab | ble to apply procedure | s of the conception and dimens | ioning to to practica | al problems of st | ructural engineeri |
| | They are capable to draft concrete buildings and to design them for general action effects and to plan their detailin | | | | | |
| | They are capable | to arane conterete ban | dings and to design them for | general action effe | ects and to plan | their detailing a |
| | | | dings and to design them for In and construction sketches and | | | their detailing a |
| | | | | | | their detailing a |
| Personal Competence | execution. Moreove | r, they can make desig | n and construction sketches and | | | their detailing a |
| - | execution. Moreove | r, they can make desig | | | | their detailing a |
| Social Competence | execution. Moreove | r, they can make designler, they can make designler | in and construction sketches and high quality in teamwork. | d draw up technical | descriptions. | |
| Social Competence | execution. Moreove | r, they can make designler, they can make designler | n and construction sketches and | d draw up technical | descriptions. | |
| Social Competence Autonomy | execution. Moreove The students are ab The students are ab | r, they can make designler, they can make designler | in and construction sketches and high quality in teamwork. x conception and dimensioning t | d draw up technical | descriptions. | |
| Social Competence Autonomy | execution. Moreove The students are ab The students are ab Independent Study | r, they can make designle to obtain results of ole to carry out comple | in and construction sketches and high quality in teamwork. x conception and dimensioning t | d draw up technical | descriptions. | |
| Social Competence Autonomy Workload in Hours | execution. Moreove The students are ab The students are ab Independent Study 6 Compulsory Bonus | r, they can make designed ole to obtain results of ole to carry out comple Time 110, Study Time Form | in and construction sketches and high quality in teamwork. x conception and dimensioning to in Lecture 70 Description | d draw up technical | descriptions. | |
| Social Competence Autonomy Workload in Hours Credit points | execution. Moreove The students are ab The students are ab Independent Study 6 | r, they can make designed ole to obtain results of ole to carry out comple Time 110, Study Time | in and construction sketches and high quality in teamwork. x conception and dimensioning t in Lecture 70 | d draw up technical | descriptions. | |
| Social Competence Autonomy Workload in Hours Credit points | execution. Moreove The students are ab The students are ab Independent Study 6 Compulsory Bonus No None | r, they can make designed ole to obtain results of ole to carry out comple Time 110, Study Time Form | in and construction sketches and high quality in teamwork. x conception and dimensioning to in Lecture 70 Description | d draw up technical | descriptions. | |
| Social Competence Autonomy Workload in Hours Credit points Course achievement | execution. Moreove The students are ab The students are ab Independent Study 6 Compulsory Bonus No None Written exam | r, they can make designed ole to obtain results of ole to carry out comple Time 110, Study Time Form | in and construction sketches and high quality in teamwork. x conception and dimensioning to in Lecture 70 Description | d draw up technical | descriptions. | |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination | execution. Moreove The students are ab The students are ab Independent Study 6 Compulsory Bonus No None Written exam | r, they can make designed ole to obtain results of ole to carry out comple Time 110, Study Time Form | in and construction sketches and high quality in teamwork. x conception and dimensioning to in Lecture 70 Description | d draw up technical | descriptions. | |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale | execution. Moreove The students are ab The students are ab Independent Study 6 Compulsory Bonus No None Written exam 120 minutes | r, they can make designed ole to obtain results of ole to carry out comple Time 110, Study Time Form Presentation | in and construction sketches and high quality in teamwork. x conception and dimensioning to in Lecture 70 Description | d draw up technical | descriptions. | |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | execution. Moreove The students are ab The students are ab Independent Study 6 Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Sp | r, they can make designed ole to obtain results of ole to carry out comple Time 110, Study Time Form Presentation | in and construction sketches and high quality in teamwork. x conception and dimensioning to in Lecture 70 Description Es werden 2 Referate a | d draw up technical | descriptions. | |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | execution. Moreove The students are ab The students are ab Independent Study 6 Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Sp Civil Engineering: Sp | r, they can make designed ole to obtain results of ole to carry out comple Time 110, Study Time Form Presentation pecialisation Structura pecialisation Geotechn | in and construction sketches and high quality in teamwork. x conception and dimensioning in in Lecture 70 Description Es werden 2 Referate a | d draw up technical asks of structures u nusgegeben | descriptions. | |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | execution. Moreove The students are ab The students are ab Independent Study 6 Compulsory Bonus No None Written exam 120 minutes Civil Engineering: SI Civil Engineering: SI Civil Engineering: SI | r, they can make designed ole to obtain results of ole to carry out comple Time 110, Study Time Form Presentation pecialisation Structura pecialisation Geotechn pecialisation Coastal E | in and construction sketches and high quality in teamwork. x conception and dimensioning in in Lecture 70 Description Es werden 2 Referate a Engineering: Compulsory ical Engineering: Elective Comp | d draw up technical asks of structures u nusgegeben | descriptions. | |
| Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | execution. Moreover The students are ab The students are ab Independent Study 6 6 Computsory Bonus No None Written exam 120 minutes Civil Engineering: SI Civil Engineering: SI Civil Engineering: SI Civil Engineering: SI | r, they can make designed ole to obtain results of ole to carry out comple Time 110, Study Time Form Presentation pecialisation Structura pecialisation Geotechn pecialisation Coastal E pecialisation Water and | in and construction sketches and high quality in teamwork. x conception and dimensioning in in Lecture 70 Description Es werden 2 Referate a Engineering: Compulsory ical Engineering: Elective Compulsory ngineering: Elective Compulsory | d draw up technical asks of structures u ausgegeben | descriptions. | |

| Course L0579: Concrete Stru | ictures |
|-----------------------------|---|
| Тур | Seminar |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | NN |
| Language | DE |
| Cycle | WiSe |
| Content | With help of a project teamwork the subjects of the course "Concrete Structures" is practiced, discussed and presented. |
| Literature | - Projektbezogene Unterlagen werden abgegeben. |

| Course L0578: Structural Concrete Members | | |
|---|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | NN | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|------------------------------------|--|--------------------------|---------------|-------------------|
| Title | Тур | | Hrs/wk | СР |
| Integrated Transportation Planning | | problem-based Learning | 4 | 6 |
| Module Responsible | Prof. Carsten Gertz | | | |
| Admission Requirements | | | | |
| Recommended Previous | some knowledge of transport planning, e.g. through taking the undergrad | luate class "Transport P | lanning and T | raffic Engineerin |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the following learning | ng results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to: | | | |
| | describe interdependencies between land-use/location choice and | transportation/mobility | hehaviour | |
| | explain and evaluate the social, ecological and economic effects of | | | ires |
| | relate current issues in the area of integrated transport planning and | | | |
| | · · · · · · · · · · · · · · · · · · · | | | |
| Skills | Students are able to: | | | |
| | | and influenced by th | | |
| | quantify important parameters, which influence travel demand or a comprehensively examine a pre-defined or self-selected topic from | | os porspostiv | a and document t |
| | results in accordance with scientific conventions. | | es perspectiv | |
| Personal Competence | | | | |
| - | Students are able to: | | | |
| , | | | | |
| | provide feedback on topical contents and their teaching. | | | |
| | constructively handle feedback on their own work. produce results in group work and decument these | | | |
| | produce results in group work and document these. | | | |
| Autonomy | Students are able to: | | | |
| | assess potential consequences of their future professional activitie | S | | |
| | independently plan working on a pre-defined project topic, acquire | | ge and use a | ppropriate means |
| | its execution. | ,, | 5 | |
| | | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | Written elaboration | | | |
| Examination duration and | written assignment with presentation during the semester | | | |
| scale | where assignment was presentation during the semester | | | |
| | Civil Engineering: Specialisation Structural Engineering: Elective Compuls | ory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Elective Comp | • | | |
| - | Civil Engineering: Specialisation Coastal Engineering: Elective Compulsor | y | | |
| | Civil Engineering: Specialisation Water and Traffic: Compulsory | | | |
| | Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mo | bility: Elective Compuls | ory | |
| | Water and Environmental Engineering: Specialisation Cities: Compulsory | | | |

| Course L1068: Integrated Tr | ansportation Planning |
|-----------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| СР | 6 |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Lecturer | Prof. Carsten Gertz, Dr. Philine Gaffron, Jacqueline Bianca Maaß |
| Language | DE |
| Cycle | WiSe |
| | The course will provide students with an understanding of interdependencies between land-use and transportation. Specific topics include a.o.: interactions between transport and the environment and consequent limitations characteristics of integrated planning complex planning processes interdependencies of location choice and mobility behaviour transport and land-use policies project on current issues in transportation studies |
| Literature | Kutter, Eckhard (2019) Stadtstruktur und Erreichbarkeit in der postfossilen Zukunft. Erich Schmidt Verlag. Berlin. Gies, Huber u. a. (Hrsg.) (93. Ergänzung 2022) Handbuch der kommunalen Verkehrsplanung. Herbert Wichmann Verlag. Berlin, Offenbach. (Loseblattsammlung mit kontinuierlichen Ergänzungen) |

| Module M0963: Steel | and Composite Structures | | | |
|------------------------------------|---|--|---------|----|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Steel and Composite Structures (L1 | 204) | Lecture | 2 | 2 |
| Steel and Composite Structures (L1 | | Recitation Section (large) | 2 | 2 |
| Steel Bridges (L1097) | | Lecture | 2 | 2 |
| Module Responsible | Prof. Marcus Rutner | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basics of steel construction (i.e. Steel Structures I an | d II, BUBC) | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached | the following learning results | | |
| Professional Competence | | | | |
| | After successful completition, students can | | | |
| | | | | |
| | describe the phenomenon of local buckling | | | |
| | explain warping torsion | | | |
| | illustrate the behaviour of composite structure | | | |
| | specify the principles in design of composite s | | | |
| | sketch the contructions of steel and composite | e bridges | | |
| Skills | After successful participation students are able to | | | |
| | check stiffened and unstiffened plated structu | res | | |
| | recognize and verify warping tosion in strucure | es | | |
| | design composite structures | | | |
| | design bridges and o perform the detailing | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 8 | 4 | | |
| Credit points | | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 180 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering | ng: Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engine | | | |
| - | Civil Engineering: Specialisation Coastal Engineering | | | |
| | Civil Engineering: Specialisation Water and Traffic: El | ective Compulsory | | |
| | Civil Engineering: Specialisation Computational Engir | | | |
| | International Management and Engineering: Specialis | sation II. Civil Engineering: Elective Com | oulsory | |

| Course L1204: Steel and Con | Course L1204: Steel and Composite Structures | | |
|-----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Marcus Rutner | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Local-buckling of plated structures Warping torsion Composite-girders, -columns, -slabs, -bridges Principles in composite constructions Bridge-design and -construction | | |
| Literature | Petersen, C.: Stahlbau, 4.Auflage 2013, Springer-Vieweg Verlag Minnert, J. Wagenknecht, G.: Verbundbau-Praxis - Berechnung und Konstruktion nach Eurocode 4, 2.Auflage 2013, Bauwerk Beuth Verlag | | |

| ourse L1205: Steel and Composite Structures | | |
|---|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Marcus Rutner | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L1097: Steel Bridges | |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Yves Freundt |
| Language | |
| Cycle | |
| Content | Lecture Contents ,Steel Bridge Construction' DrIng. Jörg Ahlgrimm |
| | - From tendering and contracting to completion - the development of a steel bridge |
| | - Contents of a bridge static - structural details, examples of analysis in detail: |
| | -> effective width in regard to the longitudinal stiffeners |
| | -> Bearing point, bearing stiffener |
| | -> Crossbeam breakthrough, crossbeam reinforcement |
| | -> Analysis of the Rib-to-Floorbeam (RF) connection (web-tooth of the floorbeam between trapezoidal shaped Ribs) |
| | - Steel grades, -designation, testing methods and approval certificates |
| | - Nondestructive weld inspecting |
| | - Corrosion protection |
| | - Bridge bearing - types, format, function, dimensioning, installation |
| | - Expansion Joints |
| | - Oscillation of bridge hangers and cables - oscillation damper |
| | - Opening bridges- Detailed reviews to different assembling procedures and - implements |
| | - Selective damage events |
| | Requirements: Basic knowledge in the calculation, dimensioning, and construction of structural elements and joints of constructional steelwork |
| Literature | |
| | Herbert Schmidt, Ulrich Schulte, Rainer Zwätz, Lothar Bär: Ausführung von Stahlbauten |
| | • Petersen, Christian: Stahlbau, Abschnitt Brückenbau |
| | Ahlgrimm, J., Lohrer, I.: Erneuerung der Eisenbahnüberführung in Fulda-Horas über die Fulda, Stahlbau 74 (2005), Heft 2, S. 114 |

| Courses | | |
|---|--|--|
| Title | Typ Hrs/wk CP | |
| Module Responsible | Prof. Peter Fröhle | |
| Admission Requirements | None | |
| Recommended Previous | Subjects of the Port and Coastal Engineering specialisation. | |
| Knowledge | | |
| Educational Objectives | After taking part successfully, students have reached the following learning results | |
| Professional Competence | | |
| Knowledge | The students are able to demonstrate their detailed knowledge in the field of port and coastal engineering. They can exemplify t state of technology and application and discuss critically in the context of actual problems and general conditions of science a society. | |
| | The students can develop solving strategies and approaches for fundamental and practical problems in port and coas engineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view poin of science and society. | |
| Skills | Scientific work techniques that are used can be described and critically reviewed. The students are able to independently select methods for the project work and to justify this choice. They can explain how the methods relate to the field of work and how the context of application has to be adjusted. General findings and furth developments may essentially be outlined. | |
| Personal Competence | | |
| Social Competence | The students are able to condense the relevance and the structure of the project work, the work steps and the sub-problems the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to th colleagues. | |
| Autonomy | The students are capable of independently planning and documenting the work steps and procedures while considering the giv deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedba from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology | |
| Workload in Hours | Independent Study Time 180, Study Time in Lecture 0 | |
| Credit points | 6 | |
| Course achievement | None | |
| Examination | Study work | |
| Examination duration and scale | The number of pages depends on the task. | |
| Assignment for the Following Curricula | Civil Engineering: Specialisation Coastal Engineering: Compulsory | |

Module M0969: Selected Topics in Civil Engineering

| Courses | | | | |
|---|---|---|-------------------|----------------------|
| Title | | Тур | Hrs/wk | СР |
| Design of Composite Bridges (L3092) | | Integrated Lecture | 2 | 3 |
| Analysis of Offshore Structures (L1867) | | Lecture | 1 | 1 |
| Energy Geotechnics (L3227) | | Lecture | 3 | 3 |
| Solid Matter Process Technology fo | r Biomass (L0052) | Lecture | 2 | 3 |
| Forum I - Geotechnics and Construction Management (L1634) | | Seminar | 1 | 1 |
| Forum II - Geotechnics and Constru | ction Management (L1635) | Seminar | 1 | 1 |
| Timber Structures (L1151) | | Seminar | 2 | 2 |
| Innovative Timber Construction (L2 | 666) | Lecture | 2 | 4 |
| Glass Structures (L1152) | | Lecture | 2 | 2 |
| Glass Structures (L1447) | | Recitation Section (large) | 1 | 1 |
| Sustainable landfill design and oper | ration (L3270) | Integrated Lecture | 3 | 3 |
| Special Topics in Steel Design (L30 | 91) | Integrated Lecture | 2 | 3 |
| Special topics of civil engineering 1 | CP (L2378) | | 1 | 1 |
| Special topics of civil engineering 2 | 2 LP (L2379) | | 2 | 2 |
| Special topics of civil engineering 3 | 3 LP (L2380) | | 3 | 3 |
| Structural Design (L2789) | | Seminar | 2 | 2 |
| Module Responsible | Prof. Frank Schmidt-Döhl | | | |
| Admission Requirements | None | | | |
| Recommended Previous | none | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reache | ed the following learning results | | |
| Professional Competence | | | | |
| Knowledge | | | | |
| | • Students are able to find their way through selected special areas within civil and structural engineering. | | | |
| | • Students are able to explain basic models and procedures in selected special areas of civil and structural engineering. | | | |
| | Students are able to interrelate scientific and | l technical knowledge. | | |
| | | | | |
| | | | | |
| Skills | Students are able to apply basic methods in selected areas of civil and structural engineering. | | | |
| | • Students are usic to upply busic methods in . | science areas of civil and structural engin | icering. | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | | | | |
| Autonomy | Students can chose independently, in which | fields they want to deepen their knowled | dge and skills th | rough the election o |
| | courses. | | | |
| | | | | |
| Workload in Hours | , | | | |
| Credit points | 6 | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineer | ring: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engin | eering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Coastal Engineering | g: Elective Compulsory | | |
| | Civil Engineering: Specialisation Water and Traffic: I | , | | |
| | Civil Engineering: Specialisation Computational Eng | | | |
| | ervir Engineering. Specialisation computational Eng | meeting. Elective compaisory | | |

| Course L3092: Design of Composite Bridges | |
|---|---|
| Тур | Integrated Lecture |
| Hrs/wk | 2 |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Examination Form | Klausur |
| Examination duration and | 90 min |
| scale | |
| Lecturer | Prof. Marcus Rutner |
| Language | DE |
| Cycle | SoSe |
| Content | |
| Literature | |

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| Course L1867: Analysis of Of | |
|------------------------------|---|
| Тур | Lecture |
| | |
| CP Workload in Hours | 1 Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | |
| Examination duration and | |
| scale | |
| Lecturer | Dr. Said Fawad Mohammadi |
| Language | DE/EN |
| Cycle | SoSe |
| Content | Topic 1: Types of Offshore Structures, Fixed and floating structures for Oil & Gas and Offshore Wind industry |
| | Topic 2: Wave Forces, Morisons equation |
| | Topic 3: Irregular Seastates, Power spectrum and application of FFT |
| | Topic 4: Additional Environmental Forces, wind spectra, current forces |
| | Topic 5: Linear-Time-Invariant Systems, response of an LTI-system in frequency domain |
| | Topic 6: Tubular Welded Connections, stress concentration factors, weld geometry |
| | Topic 7: Introduction to Fracture Mechanics, criteria for fracture initiation and crack growth |
| | Topic 8: Time and Frequency Domain Fatigue Analyses, rainflow counting, application of LTI-systems for frequency domain fatigue |
| | Topic 9: Offshore Installation and Exam, installation of structures, pile driving, pipe laying techniques |
| Literature | Chakrabarti, Handbook of Offshore Engineering, 2005 |
| | Sarpkaya, Wave Forces on Offshore Structures, 2010 |
| | Faltinsen, Sea Loads on Ships and Offshore Structures, 1998 |
| | Sorensen, Basic Coastal Engineering, 2006 |
| | Dowling, Mechanical Behavior of Materials, 2007 |
| | Haibach, Betriebsfestigkeit, 2006 |
| | Marshall, Design of Welded Tubular Connections, 1992 |
| | Newland, Random vibrations, spectral and wavelet analysis, 1993 |
| | |

| Course L3227: Energy Geotechnics | | |
|----------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | |
| Examination Form | Schriftliche Ausarbeitung (laut FPrO) | |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt | |
| scale | | |
| Lecturer | Pauline Kaminski | |
| Language | DE/EN | |
| Cycle | WiSe | |
| Content | Energy geotechnics is a young field in geotechnical engineering with the aim of developing sustainable geotechnical solutions for future-oriented issues relating to the production, transport, operation, decommissioning, and waste utilisation of various energy sources. Examples of possible fields of activity in energy geotechnics include geothermal energy and thermally activated foundation components, foundations for onshore and offshore wind turbines, the decommissioning of mining facilities and the handling of waste products from fossil fuels such as tailings and the geological storage of CO2. Relevant soil mechanical processes in these applications include the thermo-hydro-mechanically coupled behaviour of soils, multiphase flow in porous media and partially saturated soils. The lecture gives an overview of various aspects of energy geotechnics and provides in-depth knowledge of the associated soil mechanical processes. In addition, CO2-scarce geotechnical applications are discussed and emission estimates as well as the optimisation of geotechnical structures according to sustainability aspects are addressed. | |
| Literature | | |

| Course L0052: Solid Matter F | Process Technology for Biomass |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Examination Form | Klausur |
| Examination duration and | 60 min |
| scale | |
| Lecturer | Prof. Werner Sitzmann |
| Language | DE |
| Cycle | SoSe |
| Content | The industrial application of unit operations as part of process engineering is explained by actual examples of solid biomass |
| | processes. Size reduction, transportation and dosing, drying and agglomeration of renewable resources are described as important |
| | unit operations when producing solid fuels and bioethanol, producing and refining edible oils, when making Btl - and WPC - |
| | products. Aspects of explosion protection and plant design complete the lecture. |
| Literature | Kaltschmitt M., Hartmann H. (Hrsg.): Energie aus Bioamsse, Springer Verlag, 2001, ISBN 3-540-64853-4 |
| | Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz, Schriftenreihe Nachwachsende Rohstoffe, |
| | Fachagentur Nachwachsende Rohstoffe e.V. www.nachwachsende-rohstoffe.de |
| | Bockisch M.: Nahrungsfette und -öle, Ulmer Verlag, 1993, ISBN 380000158175 |
| | |

| Course L1634: Forum I - Geotechnics and Construction Management | |
|---|---|
| Тур | Seminar |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | Mündliche Prüfung |
| Examination duration and | 30 min |
| scale | |
| Lecturer | Prof. Jürgen Grabe |
| Language | DE |
| Cycle | WiSe |
| Content | Lectures about projects and issues with practical and scientific relevance. |
| Literature | |

| Course L1635: Forum II - Geotechnics and Construction Management | |
|--|---|
| Тур | Seminar |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | Mündliche Prüfung |
| Examination duration and | 30 min |
| scale | |
| Lecturer | Prof. Jürgen Grabe |
| Language | DE |
| Cycle | SoSe |
| Content | Lectures about projects and issues with practical and scientific relevance. |
| Literature | |

| Course L1151: Timber Structures | |
|---------------------------------|---|
| Тур | Seminar |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Examination Form | Referat |
| Examination duration and | 90 min |
| scale | |
| Lecturer | Prof. Torsten Faber |
| Language | DE |
| Cycle | WiSe |
| Content | |
| Literature | |

| Course L2666: Innovative Timber Construction | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 4 | |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 | |
| Examination Form | Schriftliche Ausarbeitung | |
| Examination duration and | 45 Minuten | |
| scale | | |
| Lecturer | Dr. Andreas Meisel | |
| Language | DE | |
| Cycle | WiSe | |
| Content | | |
| Literature | - Blass, J.: "Ingenieurholzbau" | |
| | - Schickhofer, G.: "BSPhandbuch: Holz-Massivbauweise in Brettsperrholz" | |
| | - Informationsdienst Holz: div. Merkblätter und Broschüren | |
| | - Wallner-Novak M.: Brettsperrholz Bemessung, Band 1 und 2 | |
| | - Gerner M.: "Fachwerk: Entwicklung, Instandsetzung, Neubau" | |
| | - Meisel, A.: "Historische Dachwerke: Beurteilung, realitätsnahe statische Analyse und Instandsetzung" | |
| | - Kempe K.: "Dokumentation Holzschädlinge" | |
| | - Huckfeldt T.: "Hausfäule- und Bauholzpilze" | |

| Course L1152: Glass Structures | | |
|--------------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Examination Form | Mündliche Prüfung | |
| Examination duration and | | |
| scale | | |
| Lecturer | Marvin Matzik | |
| Language | | |
| Cycle | WiSe | |
| Content | Glass structures | |
| | - Introduction of the material glass (production, refinement, material characteristic) | |
| | - design of facades | |
| | - facade types | |
| | - static calculation of glazing | |
| | - static calculation of facades | |
| | - load bearing behavior of glazing (plate or membrane stiffness) | |
| | - vertical / horizontal glazing with safety-related requirements | |
| | - glass structures | |
| | - fire safety of glass facades | |
| | - construction physics of facades and glazing | |
| Literature | | |

| Course L1447: Glass Structures | |
|--------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | Mündliche Prüfung |
| Examination duration and | |
| scale | |
| Lecturer | Marvin Matzik |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L3270: Sustainable la | andfill design and operation |
|------------------------------|--|
| Тур | Integrated Lecture |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Examination Form | Klausur |
| Examination duration and | 60 min |
| scale | |
| Lecturer | Dr. Marco Ritzkowski |
| Language | EN |
| Cycle | SoSe |
| Content | The course introduces the development of modern waste resource management and demonstrates the importance of landfills in the context of recycling processes. Based on international (EU) and national legislation, the current landfill situation is presented and the future significance of landfills will be discussed. A central element of the course deals with the main transformation processes in the landfilled waste, the emission of gases and leachate, the long-term behaviour of landfills as well as aftercare and after-utilisation measures. Further focal points of the course are measures for the sustainable reduction of environmentally and climate-damaging emissions and aspects of landfill technology in an international context. |
| Literature | Waste Management. Bernd Bilitewski; Georg Härdtle; Klaus Marek (Eds.), ISBN: 9783540592105, Springer Verlag Lehrbuchsammlung der TUB, Signatur USH-305 Solid Waste Technology and Management. Thomas Christensen (Ed.), ISBN: 978-1-4051-7517-3, Wiley Verlag Lesesaal 2: US - Umweltschutz, Signatur USH-332 Solid Waste Landfilling - Concepts, Processes, Technologies. Cossu, R. and Stegmann, R. (Eds.), ISBN: 978-0-12-818336-6 PDF (Volltext) über TUB |

| Course L3091: Special Topics in Steel Design | |
|--|---|
| Тур | Integrated Lecture |
| Hrs/wk | 2 |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Examination Form | Klausur |
| Examination duration and | 90 min |
| scale | |
| Lecturer | Prof. Marcus Rutner, Nikolay Lalkovski |
| Language | DE |
| Cycle | SoSe |
| Content | |
| Literature | |

| Course L2378: Special topics of civil engineering 1CP | |
|---|---|
| Тур | |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | Fachtheoretisch-fachpraktische Arbeit |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt |
| scale | |
| Lecturer | Dozenten des SD B |
| Language | DE |
| Cycle | WiSe/SoSe |
| Content | The course occurs only if required. The content is defined at short notice. |
| Literature | Die Literatur wird kurzfristig festgelegt. |

| Course L2379: Special topics of civil engineering 2 LP | |
|--|---|
| Тур | |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Examination Form | Fachtheoretisch-fachpraktische Arbeit |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt |
| scale | |
| Lecturer | Dozenten des SD B |
| Language | DE |
| Cycle | WiSe/SoSe |
| Content | The course occurs only if required. The content is defined at short notice. |
| Literature | Die Literatur wird kurzfristig festgelegt. |

| Course L2380: Special topics of civil engineering 3 LP | | |
|--|---|--|
| Тур | | |
| Hrs/wk | 3 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | |
| Examination Form | Fachtheoretisch-fachpraktische Arbeit | |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt | |
| scale | | |
| Lecturer | Dozenten des SD B | |
| Language | DE | |
| Cycle | WiSe/SoSe | |
| Content | The course occurs only if required. The content is defined at short notice. | |
| Literature | Die Literatur wird kurzfristig festgelegt. | |

| Course L2789: Structural Design | | |
|---------------------------------------|---|--|
| Тур | Seminar | |
| Hrs/wk | 2 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Examination Form | Mündliche Prüfung | |
| Examination duration and | 20 min | |
| scale | | |
| Lecturer | Dr. Jan Mittelstädt | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | | |
| Literature | [1] Structure Systems by Heino Engel, Hantje Cantz, 3rd edition (Feb 2007), ISBN-10: 3775718761 | |
| | Form and Force, Designing Efficient, Expressive Structures by Allan, E., Zalewski, W. et al, John Wiley and | |
| | Sons; 1st edition (Sept 2009), ISBN-10: 047017465X | |
| | [2] Peter Rice: An Engineer Imagines, ISBN-10 : 1849944237 | |
| | [3] Konrad Wachsmann and the Grapevine Structure by C. Sumi et al., Park Books (Oct 2018), ISBN-10: | |
| | 9783038601104 | |
| | [4] Manual of Multi-Story Timber Construction by Hermann Kaufmann, Stefan Krotsch, Stefan Winter, DETAIL, | |
| | (June 2018), ISBN-10: 3955533948 | |
| | [5] The Art of Structural Design: A Swiss Legacy by B. Billington, Princeton University Art Museum; First Edition | |
| | edition (Mar 2003), ISBN-10: 0300097867 | |
| | [6] Structured Lineages: Learning from Japanese Structural Design by G. Nordenson et al, The Museum of | |
| | Modern Art (Jul 2019), ISBN-10: 1633450562 | |
| | [7] The Structure: Works of Mahendra Raj by V. Mehta, R. Mehndiretta, A. Huber, Park Books (Oct 2015), | |
| | ISBN-10: 3038600253 | |
| i i i i i i i i i i i i i i i i i i i | | |
| | | |

| Courses | | | | |
|---|---|--|----------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Chemistry of Drinking Water Treatment (L0311) | | Lecture | 2 | 1 |
| Chemistry of Drinking Water Treatment (L0311) | | Recitation Section (large) | 1 | 2 |
| Water Resource Management (L04 |)2) | Lecture | 2 | 2 |
| Water Resource Management (L04 | 03) | Recitation Section (small) | 1 | 1 |
| Module Responsible | Prof. Mathias Ernst | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Knowledge of water management and th | e key processes involved in water treatment. | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students h | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students will be able to outline key area | as of conflict in water management, as well as th | eir mutual depen | dence for sustaina |
| | water supply. They will understand rele | vant economic, environmental and social factors | Students will be | able to explain a |
| | | vater companies. They will be able to explain the a | | • |
| | the scope of their application. | ater companies. They will be able to explain the a | | finenc processes |
| | | | | |
| Skills | Students will be able to assess com | plex problems in drinking water production an | d establish solut | ions involving w |
| | | hey will be able to assess the evaluation methods | | |
| | 5 | ons for selected treatment processes and apply g | | |
| | | sing for selected treatment processes and apply (| generally accepted | |
| | standards to these processes. | | | |
| Personal Competence | | | | |
| Social Competence | Working in a diverse group of specialists | s, students will be able to develop and document | complex solutions | for the managen |
| <i>p</i> | • • • • | will be able to take an appropriate professional p | | • |
| | | nt solutions in teams of diverse experts and preser | | |
| | interests. They will be able to develop joi | The solutions in teams of diverse experts and preser | it these solutions i | to others. |
| Autonomy | Students will be in a position to work on a | a subject independently and present on this subjec | t. | |
| Workload in Hours | Independent Study Time 96, Study Time | in Locture 94 | | |
| Credit points | | III Lecture 64 | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| | 60 min (chemistry) + presentation | | | |
| scale | oo min (chemistry) + presentation | | | |
| Assignment for the | Civil Engineering: Specialisation Structure | al Engineering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotech | | | |
| i onowing curricula | Civil Engineering: Specialisation Geotech | | | |
| | Civil Engineering: Specialisation Water al | | | |
| | | | 201 | |
| | | echnical Complementary Course: Elective Compulso | • | Commute |
| | | ng: Specialisation II. Energy and Environmental Eng | | compulsory |
| | | conmental Process Engineering: Elective Compulsor | У | |
| | Process Engineering: Specialisation Proce | | | |
| | Water and Environmental Engineering: S | pecialisation Water: Compulsory | | |
| | Water and Environmental Engineering: S | pecialisation Environment: Elective Compulsory | | |
| | | | | |

| Course L0311: Chemistry of | Drinking Water Treatment |
|----------------------------|---|
| | Lecture |
| Hrs/wk | |
| CP | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Dr. Klaus Johannsen |
| Language | DE |
| Cycle | WiSe |
| Content | The topic of this course is water chemistry with respect to drinking water treatment and water distribution |
| | Major topics are solubility of gases, carbonic acid system and calcium carbonate, blending, softening, redox processes, materials and legal requirements on drinking water treatment. Focus is put on generally accepted rules of technology (DVGW- and DIN- standards). Special emphasis is put on calculations using realistic analysis data (e.g. calculation of pH or calcium carbonate dissolution potential) in exercises. Students can get a feedback and gain extra points for exam by solving problems for homework. Knowledge of drinking water treatment processes is vital for this lecture. Therefore the most important processes are explained coordinated with the course " Water resources management" in the beginning of the semester. |
| Literature | MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John Wiley & Sons, Hoboken, 2005. Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley & Sons, New York, 1996. DVGW (Hrsg.): Wasseraufbereitung - Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004. Jensen, J. N.: A Problem Solving Approach to Aquatic Chemistry. John Wiley & Sons, Inc., New York, 2003. |

| Course L0312: Chemistry of Drinking Water Treatment | |
|---|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| CP | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Dr. Klaus Johannsen |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L0402: Water Resour | rce Management |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Mathias Ernst |
| Language | DE |
| Cycle | WiSe |
| Content | The lecture provides comprehensive knowledge on interaction of water ressource management and drinking water supply. Content |
| | overview: • Current situation of global water resources • User and Stakeholder conflicts • Wasserressourcenmanagement in urbane Gebieten • Rechtliche Aspekte, Organisationsformen Trinkwasserversorgungsunternehmen. • Ökobilanzierung, Benchmarking in der Wasserversorgung |
| Literature | Aktuelle UN World Water Development Reports Branchenbild der deutschen Wasserwirtschaft, VKU (2011) Aktuelle Artikel wissenschaftlicher Zeitschriften Ppt der Vorlesung |

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| Course L0403: Water Resour | ourse L0403: Water Resource Management | |
|----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Mathias Ernst | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|------------------------------------|--|---------------------------------------|-----------------|------------------|
| Title | | Тур | Hrs/wk | СР |
| Adaptation to climate change in hy | draulic engineering (L2291) | Project-/problem-based Learning | 4 | 6 |
| Module Responsible | Prof. Peter Fröhle | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | Hydrology, Hydraulic Engineering | | | |
| | Hydromechanic, Hydraulics Fundamentals of Coastal Engineering, Coastal- and F | load Protection | | |
| | Hydrological Systems | | | |
| | | | | |
| Educational Objectives | After taking part successfully, students have reached the for | llowing learning results | | |
| Professional Competence | | | | |
| Knowledge | Climate protection and climate adaptation | | | |
| | Insights into climate change and its regional character | eristics - fundamentals, climate mode | lling / climate | models |
| | Impacts of climate change on the components of the | | ing, chinace | modelo |
| | Fundamentals of analysis of climate data | | | |
| | Consequences of the impact of the climate change | | | |
| | Measures for climate adaptation | | | |
| | Assessment, prioritization and communication of ada | ptation measures | | |
| | Fundamentals of the analysis of hydrometeorological | l and hydrological data | | |
| Skills | | | | |
| SKIIS | Critical thinking: analysis of processes and relations, | assessment of needs for action | | |
| | Creative thinking: development of adaptation strateg | | | |
| | Practical thinking: inclusion of restrictions, application | tion of calculation approaches, meth | ods, numeric | al models, planr |
| | methods | | | |
| | Consideration of complex tasks | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| | Working in heterogenous groups | | | |
| | Working with different scientific / non-scientific discip | blines | | |
| | Self reflection | | | |
| Autonomy | | | | |
| | Application oriented use of knowledge and skills | | | |
| | Autonomous work on complex tasks | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | Preparation of a written report and a presentation of a com | plex task. | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Engineering: Election | ve Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: | | | |
| | Civil Engineering: Specialisation Structural Engineering: Electronic Structural Engineering: Electronic Structural Engineering: Electronic Structural Engineering: Specialisation Structural Engineering: Electronic Structural En | | | |
| | Civil Engineering: Specialisation Water and Traffic: Elective | Compulsory | | |
| | | | | |
| | Water and Environmental Engineering: Specialisation Cities Water and Environmental Engineering: Specialisation Enviro | | | |

| Course L2291: Adaptation to | climate change in hydraulic engineering |
|-----------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| СР | 6 |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Lecturer | Prof. Peter Fröhle |
| Language | DE |
| Cycle | WiSe |
| Content | Climate protection and climate adaptation Findings on climate change and its regional characteristics: fundamentals of climate change, climate modelling / climate models Impacts of climate change on the components of the regional hydrological cycle(climate science view) Fundamentals of the analysis of climate data Concequences of the impacts of climate change (ingenieering science view) Measures for climate change adaptation Assessment, prioritization and communication of measures Fundamentals of analysis of hydrometeorological and hydrological data |
| Literature | Wird bereitgestellt über die HOOU - eLearning Plattform abhängig von den jeweils schwerpunktmäßig behandelten Fragestellungen wird das Schrifttum (aktuelle Paper) in der Veranstaltung bzw. über StudIP zur Verfügung gestellt. |

| ect-/problem-based Learning ection arning results er Cycle ent of needs for action daptation measures lculation approaches, meth | Hrs/wk 4 | CP 6 |
|--|--|---|
| ect-/problem-based Learning ection arning results er Cycle ent of needs for action daptation measures | 4 | |
| arning results or Cycle ent of needs for action daptation measures | nods, numerical | models, plannir |
| arning results or Cycle ent of needs for action daptation measures | nods, numerical | models, plannir |
| arning results or Cycle ent of needs for action daptation measures | nods, numerical | models, plannir |
| er Cycle ent of needs for action daptation measures | nods, numerical | models, plannir |
| ent of needs for action daptation measures | nods, numerical | models, plannir |
| daptation measures | ods, numerical | models, plannir |
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| on and subsequent discussion | on. The work on | the complex ta |
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| compulsory pulsory ory Elective Compulsory | | |
| | ion and subsequent discussion ulsory Compulsory npulsory ory : Elective Compulsory e Compulsory Elective Compulsory e Compulsory | Compulsory npulsory iory : Elective Compulsory e Compulsory |

| Course L2926: Sustainable N | ature-based Coastal Protection in a Changing Climate (SeaPiaC) |
|-----------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| СР | 6 |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Lecturer | Prof. Peter Fröhle |
| Language | EN |
| Cycle | WiSe |
| Content | Climate and Climate Change General Impacts of Climate Change on Wind Regime and Water Cycle Consequences of Climate Change for Coastal Processes Coastal Protection in Taiwan and Germany Fundamentals of Climate Adaptation Nature-Based Solutions (NBS) for Coastal Protection |
| Literature | Materials provided on eLearning Platform (HOOU Platform) Depending on the main topics of the course in the respective year, the literature (recent papers) will be provided in the course-material or via StudIP. |

| Courses | | | | |
|--------------------------------------|---|---|----------------|-----------------|
| Title | | Тур | Hrs/wk | СР |
| Scientific Working in Computationa | Engineering (L2764) | Project-/problem-based Learning | 4 | 6 |
| Module Responsible | Prof. Kay Smarsly | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge in scientific writing. String interest in to | pics related to computing in civil engine | ering. | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the | following learning results | | |
| Professional Competence | | | | |
| <i>Skills</i> Personal Competence | course instructors and in collaboration with each other, the students will also learn to understand the complex process of scienti thinking, being able to accurately plan, implement and analyze scientific projects, such as prospective master theses. A proje will be conducted throughout the semester, which will contribute to the grade. Since scientific writing is of particular importance this course, a scientific paper will be developed based, which is a prerequisite for the final examination. The paper will be writt based on the project conducted within this course. Project meetings in small groups, presentations, and critical discussions scientific publications are further key activities. The students will be capable (i) of solving a scientific problem following a scientific methodology, (ii) of documenting their wor effectively in the form of a paper, and (iii) of sharing their work in a presentation. | | | |
| | The students will be able to work in a multidisciplinary te | am and develop communication skills n | ecessary for p | roblem solving. |
| | The students will be able to extend their knowledge and | · | | - |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | 10 pages of work with 15-minute oral presentation | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Water and Traffic: Electiv | /e Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineerin | | | |
| | Civil Engineering: Specialisation Coastal Engineering: Ele | | | |
| | Civil Engineering: Specialisation Structural Engineering: E | | | |
| | Civil Engineering: Specialisation Computational Engineer | • | | |
| | Computer Science: Specialisation II: Intelligence Engineer | ring: Elective Compulsory | | |

| Course L2764: Scientific Wor | rking in Computational Engineering |
|------------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| СР | 6 |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Lecturer | Prof. Kay Smarsly |
| Language | EN |
| Cycle | WiSe/SoSe |
| Content | In the course, a scientific problem of practical relevance will first be defined, taking into account the interests of the students participating in the course. The scientific problem will then systematically be solved within the framework of a comprehensive project. The principles of scientific working will be taught based on the scientific problem defined previously. As an integral part of scientific working, fundamentals of scientific writing will be presented and applied to a scientific paper to be written during the course. Topics related to scientific writing include structuring in scientific writing (structuring the abstract, the introduction, the main part, the summary and conclusions, and the acknowledgments and references) and recommendations on effective scientific writing (principles of composition, use of English in scientific writing, useful tips, creating figures, writing in mathematics, referencing, and formal email correspondence). A final paper and a final presentation will be assembled by the students. |
| Literature | Smarsly, K. & Dragos, K., 2019. Scientific Writing in Engineering. Tredition, Hamburg, Germany. |

| Courses | | | | |
|------------------------------------|--|--|--------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Modern discretization methods in s | tructural mechanics (L3043) | Lecture | 2 | 3 |
| Modern discretization methods in s | tructural mechanics (L3044) | Recitation Section (small) | 2 | 3 |
| Module Responsible | Prof. Bastian Oesterle | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Finite Element MethodsFlächentragwerke | | | |
| Educational Objectives | After taking part successfully, students have re | ached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After successful completion of this module, stu mechanics. | dents can express the basic aspects of moder | n discretization r | nethods in structu |
| Skills | After successful completion of this module, the students will be able to use and further improve modern discretization methods for problems in structural mechanics. | | | |
| Personal Competence | | | | |
| Social Competence | Students can | | | |
| | participate in subject-specific and interd | sciplinary discussions. | | |
| | defend their own work results in front of | | | |
| | promote the scientific development of compared of the scientific development of compared of the science of the sc | | | |
| | Furthermore, they can give and accept p | • | | |
| Autonomy | Students are able to gain knowledge of the sub | niect area from given and other sources and ar | only it to new pro | blems Furthermo |
| | they are able to structure the solution process | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Le | cture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Engine | ering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical E | ingineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Structural Engi | neering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Computational | Engineering: Elective Compulsory | | |
| | Theoretical Mechanical Engineering: Specialisa | tion Simulation Technology: Elective Compulso | ry | |

| Тур | Lecture |
|-------------------|---|
| Hrs/wk | |
| СР | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Bastian Oesterle |
| Language | EN |
| Cycle | WiSe |
| Content | The course covers variational formulations, various locking phenomena and alternative formulations for finite elements and modern discretization schemes in the context of structural mechanics, like isogeometric analysis. variational formulation of finite elements, mixed variational principles geometrical and material locking effects in structural and solid mechanics hybrid-mixed and enhanced assumed strain finite element formulations, reduced integration and stabilization, DSG method, u-p formulations patch test, stability, convergence linear and non-linear analyses introduction to isogeometric analysis isogeometric beam, plate and shell formulations locking effects and their avoidance in modern, smooth discretization schemes, like isogeometric analysis |
| Literature | lecture notes and selected scientific papers O.C. Zienkiewicz, R.L. Taylor, and J.Z. Zhu: Finite Element Method: Its Basis and Fundamentals. Elsevier, 2013. J. Austin Cottrell, Thomas J. R Hughes, Yuri Bazilevs: Isogeometric Analysis: Toward Integration of CAD and FEA. Wiley, 2009. |

| Course L3044: Modern discre | urse L3044: Modern discretization methods in structural mechanics | |
|-----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Bastian Oesterle | |
| Language | EN | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| - | | | | |
|---|---|---|--------------------------|--------------------|
| Courses | | | | |
| Fitle | ······································ | Тур | Hrs/wk | СР |
| Construction law BGB and VOB - la Construction disputes from constru | ction (excavation) practice (L3182) | Lecture Lecture | 2 | 3 3 |
| Module Responsible | | | | - |
| Admission Requirements | None | | | |
| | Complete modules: Geotechnics I-III | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have rea | ached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students will gain knowledge of | | | |
| | the history of civil engineering law, | | | |
| | basics of foundation and civil engineering | g law, | | |
| | legal aspects of technical regulations in c | ivil engineering (with case studies), | | |
| | the civil engineering contract, | | | |
| | the liability of the designer and contractor | r in civil engineering, | | |
| | the subsoil risk and the system risk, the total dabt in (civil) anginagring law | | | |
| | the total debt in (civil) engineering law, the (construction) conflict, dispute avoidation | ance models and the construction proc | 055 | |
| | the (construction) connect, dispute avoid the systematics of construction contract | | c35, | |
| | the BGB construction contract law, | , | | |
| | responsibilities on the construction site, | | | |
| | remuneration and contract management | , | | |
| | liability for defects, | | | |
| | public procurement law | | | |
| | Disturbed construction processes: How m | nuch money am I entitled to? | | |
| | Correct calculation of supplements. | | | |
| Skills | Students learn to apply legal aspects in plannir | ng and construction in a legally balanc | ed way. Students learn l | now to use legal a |
| | construction management aspects in practice (| | | |
| | to manage the construction project optimally. | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Students can work in groups and support each o | other in finding solutions. | | |
| Autonomy | Students are able to assess their own strengths | and weaknesses and organize their tir | me and learning manage | ment based on thi |
| Workload in Hours | Independent Study Time 124, Study Time in Lea | cture 56 | | |
| Credit points | 6 | | | |
| Course achievement | | | | |
| Examination | Oral exam | | | |
| | 30 min | | | |
| scale | | | | |
| • | Civil Engineering: Specialisation Coastal Engine | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical E | | | |
| | Civil Engineering: Specialisation Structural Engin | • • • | | |
| | Civil Engineering: Specialisation Water and Traf | ne. Liective compuisory | | |

| Course L3182: Construction | rse L3182: Construction law BGB and VOB - law in (excavation) practice | | |
|----------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Günther Schalk | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | | | |
| Literature | Literatur: | | |
| | - Folienskript (in der Vorlesung erhältlich) | | |
| | - Fuchs/Maurer/Schalk: Handbuch Tiefbaurecht | | |

| Course L3181: Construction | rse L3181: Construction disputes from construction (excavation) practice | |
|----------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Ingo Junker | |
| Language | DE | |
| Cycle | WiSe | |
| Content | | |
| Literature | | |

| Courses | | | | | |
|--|---|--------------------------------------|---------------------|-----------------------|--------------------|
| Title | | Тур | | Hrs/wk | СР |
| Coastal- and Flood Protection (L080 | 8) | Lecture | | пі 5/ w к 2 | 3 |
| Coastal- and Flood Protection (L141 | - / | | m-based Learning | 1 | 1 |
| Maintenance and Defence of Flood | Protection Structures (L1411) | Lecture | 5 | 2 | 2 |
| Module Responsible | Prof. Peter Fröhle | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Coastal Engineering I | | | | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students have | e reached the following learning res | ults | | |
| Professional Competence | | | | | |
| Knowledge | The students have the capability to define | and explain in detail the importan | t aspects of erosic | on protection | and flood protecti |
| | and are able to apply the aspects to practical coastal protection problems. They are able to design and dimension important | | | | |
| | coastal protection measures from the function | onal and from the constructional po | pint of view. | | |
| Skills The students are able to select design approaches for the functional and constructional design of erosion a | | | and flood protect | | |
| Skiis | measures and apply these approaches to practical design tasks. | | | | |
| | | 5 | | | |
| Personal Competence | | | | | |
| Social Competence | The students are able to deploy their gain | • • • • | | | - |
| | coastal and flood protection structures. Add | | | | isciplines. |
| - | The students will be able to independently e | •, | to new problems. | | |
| | Independent Study Time 110, Study Time in Lecture 70 | | | | |
| Credit points | | | | | |
| Course achievement | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and | The duration of the examination is 130 m | in. The examination includes tasks | s with respect to | the general u | inderstanding of t |
| scale | lecture contents and calculations tasks. | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Eng | jineering: Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnic | al Engineering: Elective Compulsor | ý | | |
| | Civil Engineering: Specialisation Structural E | | | | |
| | Environmental Engineering: Specialisation E | nvironment and Climate: Elective C | Compulsory | | |
| | | | | | |
| | Environmental Engineering: Specialisation V Water and Environmental Engineering: Specialisation | | | lsory | |

| Course L0808: Coastal- and Flood Protection | | |
|---|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | dependent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Peter Fröhle | |
| Language | EN | |
| Cycle | WiSe | |
| Content | Protection of sandy coasts | |
| | Sediment transport Morphology Technical solution for the protection of sandy coasts Construction in direction of the coast Constructions perpendicular to the coast Other Concepst Calculation approaches and numerical models Flood Protection Classification of constructions / measures Dikes Dunes Foreland - constructions | |
| Literature | Flood-Protection Walls Drainage of the hinterland Vorlesungsumdruck | |
| | Coastal Engineering Manual CEM | |

| Course L1415: Coastal- and I | urse L1415: Coastal- and Flood Protection | | |
|------------------------------|---|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Peter Fröhle | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Course L1411: Maintenance | and Defence of Flood Protection Structures |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Olaf Müller |
| Language | EN |
| Cycle | WiSe |
| Content | Dike protection Maintennance of flood protection measures |
| Literature | Vorlesungsumdruck |

| Courses | | | | |
|--|---|---|----------------|--------------------|
| Courses | | | | |
| Title | (1.0220) | Тур | Hrs/wk | СР |
| Waste and Environmental Chemist Biological Waste Treatment (L0318 | | Practical Course Project-/problem-based Learning | 2 3 | 2 |
| Module Responsible | | Troject (problem bused Learning | 5 | 7 |
| | | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | chemical and biological basics | | | |
| Educational Objectives | After taking part successfully, students have reach | ad the following learning results | | |
| | After taking part successfully, students have reach | ed the following learning results | | |
| Professional Competence | The medule sime persons knowledge concerning th | a planning of biological wasta traatment plan | ta Ctudanta a | ra abla ta avalair |
| Kilowiedge | The module aims possess knowledge concerning the design and layout of anaerobic and aerobic waste t plants for biological waste treatment plants and ex | treatment plants in detail, describe different te | | |
| Skills | The students are able to discuss the compilation of design and layout of plants. They can critically evaluate techniques and qua control measurements. The students can recherché and evaluate literature and date connected to the tasks given in der mod and plan additional tests. They are capable of reflecting and evaluating findings in the group. | | | |
| Personal Competence | | | | |
| | Students can participate in subject-specific and in | terdisciplinary discussions, develop cooperate | ed solutions a | nd defend their |
| | work results in front of others and promote the saccept professional constructive criticism. | | | |
| Autonomy | Students can independently tap knowledge from literature, business or test reports and transform it to the course projects. The are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define furt steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with potential social, economic and cultural impact. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lectur | re 70 | | |
| Credit points | | | | |
| Course achievement | Compulsory Bonus Form | Description | | |
| | Yes None Subject theoretical and | ł | | |
| | practical work | | | |
| Examination | Presentation | | | |
| Examination duration and | Elaboration and Presentation (15-25 minutes in gro | oups) | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Engineerin | ig: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engin | neering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Structural Enginee | ring: Elective Compulsory | | |
| | Civil Engineering: Specialisation Water and Traffic: | Elective Compulsory | | |
| | Bioprocess Engineering: Specialisation A - General | Bioprocess Engineering: Elective Compulsory | | |
| | Chemical and Bioprocess Engineering: Specialisation | on General Process Engineering: Elective Comp | oulsory | |
| | Chemical and Bioprocess Engineering: Specialisation | on Bioprocess Engineering: Elective Compulsor | у | |
| | Chemical and Bioprocess Engineering: Specialisation | on Chemical Process Engineering: Elective Con | npulsory | |
| | Chemical and Bioprocess Engineering: Specialisation | on Chemical and Bio process Engineering: Elec | tive Compuls | ory |
| | Environmental Engineering: Core Qualification: Con | npulsory | | |
| | International Management and Engineering: Specia | lisation II. Renewable Energy: Elective Compu | lsory | |
| | Process Engineering: Specialisation Environmental | | | |
| | Water and Environmental Engineering: Specialisation | | | |
| | Water and Environmental Engineering: Specialisation | an Environment. Elective Computerent | | |

| Course L0328: Waste and En | vironmental Chemistry |
|----------------------------|--|
| Тур | Practical Course |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Kerstin Kuchta |
| Language | EN |
| Cycle | WiSe |
| Content | The participants are divided into groups. Each group prepares a transcript on the experiment performed, which is then used as basis for discussing the results and to evaluate the performance of the group and the individual student. In some experiments the test procedure and the results are presented in seminar form, accompanied by discussion and results evaluation. Experiments ar e.g. Screening and particle size determination Fos/Tac AAS Chalorific value |
| Literature | Scripte |

| Course L0318: Biological Wa | ste Treatment | |
|-----------------------------|---|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | | |
| СР | 4 | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | |
| Lecturer | Prof. Kerstin Kuchta | |
| Language | EN | |
| Cycle | WiSe | |
| Content | Introduction biological basics determination process specific material characterization aerobic degradation (Composting, stabilization) anaerobic degradation (Biogas production, fermentation) Technical layout and process design Flue gas treatment Plant design practical phase | |
| Literature | | |

| Courses | | | | |
|-------------------------------------|--|--|--------------------|----------------------|
| Title | | Тур | Hrs/wk | СР |
| Finite element modeling of structur | es (L3046) | Lecture | 2 | 3 |
| Finite element modeling of structur | es (L3047) | Recitation Section (small) | 2 | 3 |
| Module Responsible | Prof. Bastian Oesterle | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Finite Element MethodsThin-walled structures | | | |
| Educational Objectives | After taking part successfully, students have re | eached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After successful completion of this module, stu | dents can express the basic aspects of modelli | ng of structures v | with finite elements |
| Skills | After successful completion of this module, the students will be able to model structures with finite elements and to analy structures using appropriate computational methods. | | | |
| Personal Competence | | | | |
| Social Competence | Students can | | | |
| | participate in subject-specific and interd | isciplinary discussions, | | |
| | defend their own work results in front of | others | | |
| | promote the scientific development of compared on the scientific development of compared on the science of the sc | olleagues | | |
| | Furthermore, they can give and accept p | professional constructive criticism | | |
| Autonomy | Students are able to gain knowledge of the sub they are able to structure the solution process | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Le | ecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | written elaboration of a project work (10-15 pa | ges) | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Computational | Engineering: Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Coastal Engine | eering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Geotechnical E | Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Structural Eng | ineering: Elective Compulsory | | |
| | Theoretical Mechanical Engineering: Specialisa | tion Simulation Technology: Elective Compulso | ry | |

| Course L3046: Finite element | t modeling of structures |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Bastian Oesterle |
| Language | EN |
| Cycle | WiSe |
| | Basic phenomena and aspects of the finite element modelling of structures are discussed. Besides theoretical decription of the phenomena and methods, a strong focus is on the practical use a commercial finite element software within computer-based exercises. The covered topics are: finite element modeling of trusses/beams/frames, plates subject to in-plane/out-of-plane loading and shells convergence properties of displacements and stresses singularities locking effects critical assessment, interpretation and check of results mixed-dimensional coupling of finite elements geometrically linear and non-linear, and material linear and non-linear analyses stability: bifurcation and snap-through problems dynamic problems, modal analyses |
| Literature | Vorlesungsmanuskript, Vorlesungsfolien |

| Course L3047: Finite elemen | rse L3047: Finite element modeling of structures | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Bastian Oesterle | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | | |
|-----------------------------------|--|---|------------------------|---------------------|--|
| Fitle | | Тур | Hrs/wk | СР | |
| Modeling of Subsurface Processes | L2731) | Recitation Section (small) | 3 | 3 | |
| Subsurface Solute Transport (L272 | | Lecture | 2 | 2 | |
| Subsurface Solute Transport (L272 | 9) | Recitation Section (large) | 1 | 1 | |
| Module Responsible | Prof. Nima Shokri | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Basic Mathematics, Hydrology | | | | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students ha | ave reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | Upon completion of this module, the st | udents will understand the mechanisms control | ing solute transpo | rt in soil and natu | |
| | porous media and will be able to work wi | th the equations that govern the fate and transpo | ort of solutes in porc | ous media. Analytic | |
| | numerical and experimental tools and teo | chniques will be used in this module. | | | |
| | | | | | |
| Skills | In addition to the physical insights, the students will be exposed to analytical, experimental and numerical tools and techniques in | | | | |
| | this module. This provides them with an excellent opportunity to improve their skills on multiple fronts which will be useful in the | | | | |
| | future career. | | | | |
| Personal Competence | | | | | |
| , | Teamwork & problem solving | | | | |
| Autonomy | The students will be involved in writing individual reports and presentation. This will contribute to the students' ability | | | | |
| | willingness to work independently and re- | | | | |
| Workload in Hours | Independent Study Time 96, Study Time | in Lecture 84 | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Subject theoretical and practical work | | | | |
| Examination duration and | Report | | | | |
| scale | | | | | |
| Assignment for the | Civil Engineering: Specialisation Structura | al Engineering: Elective Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechi | nical Engineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Coastal E | Engineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Water an | nd Traffic: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Computational Engineering: Elective Compulsory | | | | |
| | Chemical and Bioprocess Engineering: Te | chnical Complementary Course: Elective Compuls | sory | | |
| | Environmental Engineering: Core Qualific | ation: Compulsory | | | |
| | Process Engineering: Specialisation Envir | onmental Process Engineering: Elective Compulso | iry | | |
| | Process Engineering: Specialisation Proce | ess Engineering: Elective Compulsory | | | |
| | Water and Environmental Engineering: Sp | pecialisation Water: Compulsory | | | |
| | Water and Environmental Engineering: Sp | | | | |

| Course L2731: Modeling of S | ubsurface Processes |
|-----------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Dr. Milad Aminzadeh |
| Language | EN |
| Cycle | WiSe |
| Content | Basic usage and background of chosen computer software to calculate flow and transport in the saturated and unsaturated zone and to analyze field data like pumping test data |
| Literature | |

| ourse L2728: Subsurface Solute Transport | | |
|--|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Nima Shokri | |
| Language | EN | |
| Cycle | WiSe | |
| Content | Basic physical properties of soil: Definition and quantification; Liquid flow in soils (Darcy's law); Solute transport in soils; Practical analysis to measure dispersion coefficient in soil under different boundary conditions; Advanced topics (e.g. Application of Artificial Intelligence to predict soil salinization) | |
| Literature | - Environmental Soil Physics, by Daniel Hillel - Soil Physics, Sixth Edition, by William A. Jury and Robert Horton | |

| ourse L2729: Subsurface Solute Transport | |
|--|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Hannes Nevermann |
| Language | EN |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

Specialization Geotechnical Engineering

| Module M0699: Geote | chnics III | | | |
|-----------------------------------|---|---------------------------------------|---------------------|------------------------|
| Courses | | | | |
| Title | | Turn | Hrs/wk | СР |
| Numerical Methods in Geotechnics | (10375) | Typ Lecture | BIS/WK 3 | 3 |
| Advanced Foundation Engineering (| · · | Lecture | 2 | 2 |
| Advanced Foundation Engineering (| | Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof. lürgen Grabe | | | |
| Admission Requirements | | | | |
| | Geotechnics I and II, Mathematics I-III | | | |
| Knowledge | | | | |
| | After taking part successfully, students have reached the for | ollowing learning results | | |
| Professional Competence | | | | |
| | After successfully completing the module, students will be a | able to | | |
| | · · · · · · · · · · · · · · · · · · · | | | |
| | describe individual procedures for the geotechnical r | nonitoring of civil engineering me | asures, | |
| | reproduce exploration and investigation methods of | | | |
| | select suitable types of field and laboratory tests for | | | |
| | state the differences between various stress and def | ormation states and the physical | significance of inv | variants of the stress |
| | and distortion tensor, | | | |
| | outline the standard and special soil mechanics tests | | in benavior of soi | 11, |
| | describe continuum models and the resulting bounda as well as define boundary value problems from the | | in such a way that | t those can be called |
| | as well as define boundary value problems from the unambiguously. | neid of geotechnical engineering | in such a way tha | it they can be solved |
| Skills | Students will be able to | | | |
| | • dimension vertical drains for soil improvement of sof | t soils, | | |
| | calculate depth compaction using various appropriat | e methods, | | |
| | apply principles of horizontal bearing capacity of pile | 25, | | |
| | verify the internal and external stability of fluid-supp | orted diaphragm walls, | | |
| | evaluate the boundary conditions for the design | of a deep excavation and desig | n the individual | components of the |
| | excavation, | | | |
| | perform, evaluate and interpret tests for the descript | tion and classification of soils acco | rding to applicabl | e standards, |
| | computationally implement numerical algorithms to | solve boundary value problems, | | |
| | select and apply the types of analyses depending on | the degree of saturation, the imp | act, and the mate | erial behavior |
| | determine appropriate model parameters for different | nt possibilities and limitations of n | naterial models fo | or the grain structure |
| | of soils. | | | |
| Personal Competence | | | | |
| | Students can work in groups and support each other in find | ing solutions. | | |
| social competence | | | | |
| Autonomy | Students are able to assess their own strengths and weakn and think in terms of processes. | esses and, based on this, organize | their time and le | arning management |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | | | | |
| Examination duration and | | | | |
| scale | | | | |
| | Civil Engineering: Specialisation Structural Engineering: Cor | mpulsory | | |
| 5 | | | | |
| | Civil Engineering: Specialisation Coastal Engineering: Comp | | | |
| | Civil Engineering: Specialisation Water and Traffic: Elective | • | | |
| | Civil Engineering: Specialisation Computational Engineering | | | |
| | International Management and Engineering: Specialisation | | pulsory | |
| | - • • • • | | | |

| Course L0375: Numerical Methods in Geotechnics | | |
|--|---|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | |
| Lecturer | Dr. Hans Mathäus Stanford | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Topics: | |
| | Introduction to numerical soil mechanics Introduction to numerical mathematics Finite Element Method (analysis procedures, algorithms) Finite Element Method (application in geotechnical engineering) | |
| Literature | Wriggers P. (2001): Nichtlineare Finite-Elemente-Methoden. Springer Wriggers P. (2008): Nonlinear Finite Element Methods. Springer Deutsche Gesellschaft für Geotechnik e.V. (Hrsg., 2014): Empfehlungen des Arbeitskreises "Numerik in der Geotechnik". Ernst & Sohn | |

| Course L0497: Advanced Foundation Engineering | | |
|---|---|--|
| Тур | ecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Jürgen Grabe | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Vertical drains Piles Ground improvement (Deep Compaction, Soil mixing) Vibration driving Jet grouting Slurry wall Deep excavation | |
| Literature | EAK (2002): Empfehlungen für Küstenschutzbauwerke EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke EAB (1988): Empfehlungen des Arbeitskreises Baugruben Grundbau-Taschenbuch, Teil 1-3, (1997), Ernst & Sohn Verlag | |

| Course L0498: Advanced Foundation Engineering | |
|---|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Jürgen Grabe |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Courses | | | | | | | |
|-------------------------------------|---|--|----------------------------|----------------------------------|--------|----|--|
| Title | | | | Тур | Hrs/wk | СР | |
| Applied Tunnel Constructions (L24) |)7) | | | Lecture | 2 | 3 | |
| Introduction to tunnel construction | | | | Lecture | 1 | 2 | |
| ntroduction to tunnel construction | (L1811) | | | Recitation Section (large) | 1 | 1 | |
| Module Responsible | Prof. Jürgen Grabe | | | | | | |
| Admission Requirements | None | | | | | | |
| Recommended Previous | Modules from Bachel | or studies Civil a | and environmental engin | eering: | | | |
| Knowledge | | | | | | | |
| | Geotechnics I- | 11 | | | | | |
| Educational Objectives | After taking part suc | After taking part successfully, students have reached the following learning results | | | | | |
| Professional Competence | | | | | | | |
| Knowledge | Knowledge of different tunnel construction types as well as special methods and techniques of subsoil construction. | | | | | | |
| Skills | Basic knowledge of tunnel design as well as practical skills in structural tunnel analysis. | | | | | | |
| Personal Competence | | | | | | | |
| Social Competence | Capacity for teamwo | Capacity for teamwork concerning project management and design of tunnels. | | | | | |
| Autonomy | Promotion of indeper | ndent and creativ | ve work flow in the fram | ework of a design exercise. | | | |
| Workload in Hours | Independent Study T | ndependent Study Time 124, Study Time in Lecture 56 | | | | | |
| Credit points | 6 | | | | | | |
| Course achievement | Compulsory Bonus | Form | Description | | | | |
| | No 5 % | Excercises | | | | | |
| Examination | Written exam | | | | | | |
| Examination duration and | 120 minutes | | | | | | |
| scale | | | | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Elective Compulsory | | | | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Compulsory | | | | | | |
| | Civil Engineering: Specialisation Coastal Engineering: Compulsory | | | | | | |
| | Civil Engineering: Sp | ecialisation Wate | er and Traffic: Elective C | ompulsory | | | |
| | Civil Engineering: Sp | ecialisation Com | putational Engineering: | Elective Compulsory | | | |
| | International Manage | mont and Engin | ooring, Crossiplication II | Civil Engineering: Elective Comp | | | |

| Course L2407: Applied Tunne | Course L2407: Applied Tunnel Constructions | | |
|-----------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | ependent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | . Jürgen Grabe, Tim Babendererde | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | | | |
| Literature | | | |

| Course L0707: Introduction t | o tunnel construction | | | | |
|------------------------------|---|--|--|--|--|
| Тур | Lecture | | | | |
| Hrs/wk | 1 | | | | |
| CP | | | | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | | | |
| Lecturer | Dr. Julian Bubel | | | | |
| Language | DE | | | | |
| Cycle | WiSe | | | | |
| Content | Definitions Historical development in tunneling Geology for tunneling Hard rock tunneling (construction composite and machines) Tunnelung in temporarly stable soil with conventional construction methods Tunneling in soft soils (form of supports, shield types, compressed air application) Pipe jacking Tunnel Lining, tunnel supporting structures Calculation approaches for supporting structures in shield-driven tunnels Surveying for tunneling Safety requirements Construction Contract Literature and sources | | | | |
| Literature | Vorlesung/Übung s. www.tu-harburg.de/gbt | | | | |

| Course L1811: Introduction t | to tunnel construction | | |
|------------------------------|--|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| CP | 1 | | |
| Workload in Hours | ependent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | ulian Bubel | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | interlocking course | | |
| Literature | See interlocking course | | |

| Module M1748: Const | |
|---|---|
| Courses | |
| Fitle | Typ Hrs/wk CP |
| Construction Robotics (L2867) Module Responsible | Project-/problem-based Learning 6 6 Prof. Kay Smarsly |
| Admission Requirements | |
| Recommended Previous | |
| Knowledge | |
| Educational Objectives | After taking part successfully, students have reached the following learning results |
| Professional Competence | |
| Knowledge | Basics of robotics |
| | Applications in civil engineering |
| | Kinematics |
| Skills | Use of specific hardware |
| | Development of software routines |
| | Python programming language |
| | Image processing |
| | Basics of localization (LIDAR, SLAM) |
| Personal Competence | |
| Social Competence | Teamwork |
| | Communication skills |
| Autonomy | Independent work |
| | Independent decisions |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 |
| Credit points | 6 |
| Course achievement | None |
| Examination | Written elaboration |
| Examination duration and | |
| scale | |
| - | Civil Engineering: Specialisation Structural Engineering: Elective Compulsory |
| Following Curricula | |
| | Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory |
| | Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory |
| | Civil Engineering: Specialisation Computational Engineering: Elective Compulsory |
| | Computer Science: Specialisation II: Intelligence Engineering: Elective Compulsory |
| | Mechatronics: Core Qualification: Elective Compulsory |
| | Theoretical Mechanical Engineering: Specialisation Robotics and Computer Science: Elective Compulsory |

| Тур | Project-/problem-based Learning | | | | |
|-------------------|--|--|--|--|--|
| Hrs/wk | 6 | | | | |
| СР | | | | | |
| Workload in Hours | lependent Study Time 96, Study Time in Lecture 84 | | | | |
| Lecturer | Prof. Kay Smarsly, Jan Stührenberg | | | | |
| Language | EN | | | | |
| Cycle | WiSe | | | | |
| Content | Introduction: Robotics in civil engineering Presentation of potential topics Programming of algorithms in Python Application of software systems: LINUX distribution, ROS, CloudCompare, Application of hardware systems: Petoi Bittle Dog, Raspberry Pi, Arduino, sensing Topics considered for robotics using the Petoi Bittle Dog: Movement Use of sensors (camera, infrared,) Data structures/data acquisition Programming Topics technically relevant to building inspection: Geodetic evaluations Image processing Localization | | | | |
| Literature | Bock/Linner: Construction Robotics | | | | |
| | Verl et al.: Soft Robotics | | | | |
| | Pasquale: New Laws of robotics | | | | |

Module M0593: Building Materials and Building Preservation

| Courses | | | | | | |
|------------------------------------|---|---------------------|-----------------------|------------------------------|------------------|---------------------|
| Title | | | Тур | | Hrs/wk | СР |
| Repair of Structures (L0255) | | | Lectu | ıre | 1 | 1 |
| Mineral Building Materials (L0253) | | | Lectu | ire | 2 | 2 |
| Technology of mineral Building Mat | erials (L0256) | | Proje | ct-/problem-based Learning | 1 | 2 |
| Transport Processes in Building Ma | Transport Processes in Building Materials and Damage Processes (L0254) Lecture 1 | | | | 1 | |
| Module Responsible | Prof. Frank Schmidt-Döhl | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Basic knowledge about buildir | ig materials, build | ing physics and bu | ilding chemistry, for exam | nple by the m | nodules Principles |
| Knowledge | Building Materials and Building | Physics and Buildin | ng Materials and Bui | lding Chemistry. | | |
| Educational Objectives | After taking part successfully, s | tudents have reac | hed the following lea | irning results | | |
| Professional Competence | | | | | | |
| Knowledge | The students are able to descri | be the components | s of mineral building | materials and their function | on in detail and | d to use them for t |
| | manufacture of special mineral | building materials | . They are able to sh | ow the characteristics of m | nineral buildin | g materials. They a |
| | able to describe the manufactu | re, properties and | fields of application | of special mortars and spe | cial concretes | and the correlation |
| | of their material parameters. Th | ney are able to sho | w the principles of a | nchor technology and desi | gn. | |
| Chille | The shudents are able to reaf- | | - f | | These and a bi | |
| SKIIIS | The students are able to perform an optimization of granulometry of a mineral building material. They are able to design a special | | | | | |
| | mineral mortar and to manufacture this mortar. The students are able to manufacture post installed rebar connections. They all | | | | | |
| | able to recognize damages, to assess possible causes, to use the fundamentals of construction preservation and to select reparand strengthening measures. | | | | | |
| | | | | | | |
| Personal Competence | | | | | | |
| Social Competence | | | | | | |
| | other students. In a critical discussion they defend and adjust their results. The students are able to manufacture their speci | | | | | |
| | building material on the basis of this feedback. | | | | | |
| | | | | | | |
| Autonomy | The students are able to responsibly use the resources of materials and lab equipment for their project and to investigate and to | | | | | |
| | get missing components. | | | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | | | |
| Credit points | 6 | | | | | |
| Course achievement | Compulsory Bonus Form | | Description | | | |
| | Yes 20 % Subject | theoretical an | ıd | | | |
| | practica | l work | | | | |
| Examination | Written exam | | | | | |
| Examination duration and | 120 min | | | | | |
| scale | | | | | | |
| Assignment for the | Civil Engineering: Specialisatior | n Geotechnical Eng | ineering: Compulsor | У | | |
| Following Curricula | Civil Engineering: Specialisatior | n Coastal Engineeri | ing: Elective Compul | sory | | |
| | Civil Engineering: Specialisatior | n Structural Engine | ering: Elective Comp | oulsory | | |
| | Civil Engineering: Specialisatior | | | | | |

| Course L0255: Repair of Stru | Course L0255: Repair of Structures | | | |
|------------------------------|---|--|--|--|
| Тур | Lecture | | | |
| Hrs/wk | 1 | | | |
| СР | 1 | | | |
| Workload in Hours | ependent Study Time 16, Study Time in Lecture 14 | | | |
| Lecturer | Frank Schmidt-Döhl | | | |
| Language | DE | | | |
| Cycle | SoSe | | | |
| Content | intenance of structures, repair and strengthening, subsequent waterproofing of structures | | | |
| Literature | BetonMarketing Deutschland (Hrsg.): Stahlbetonoberflächen - schützen, erhalten, instandsetzen | | | |

| Course L0253: Mineral Buildi | ing Materials |
|------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Frank Schmidt-Döhl |
| Language | DE |
| Cycle | SoSe |
| Content | Components of mineral building materials and their function, binding materials, concrete and mortar, special mortars, special concretes |
| Literature | Taylor, H.F.W.: Cement Chemistry |
| | Springenschmid, R.: Betontechnologie für die Praxis |

| Course L0256: Technology of | ourse L0256: Technology of mineral Building Materials | | |
|-----------------------------|--|--|--|
| Тур | ject-/problem-based Learning | | |
| Hrs/wk | 1 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | of. Frank Schmidt-Döhl | | |
| Language | | | |
| Cycle | Se | | |
| Content | Design and production of a special mineral building material | | |
| Literature | lor, H.F.W.: Cement Chemistry | | |
| | Springenschmid, R.: Betontechnologie für die Praxis | | |

| Course L0254: Transport Pro | Course L0254: Transport Processes in Building Materials and Damage Processes | | |
|-----------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | ependent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | . Frank Schmidt-Döhl | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | nsport Processes in Building Materials and Damage Processes | | |
| Literature | Blaich, J.: Bauschäden, Analyse und Vermeidung | | |

| Courses | | | | | | |
|------------------------------------|---|---|---------------------|-------------|--|--|
| Title | | Тур | Hrs/wk | СР | | |
| Design of Prestressed Structures a | nd Concreet Bridges (L0603) | Lecture | 3 | 4 | | |
| Design of Prestressed Structures a | nd Concreet Bridges (L0604) | Recitation Section (large) | 2 | 2 | | |
| Module Responsible | NN | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Detailed knowledge on the design of concr | rete structures. | | | | |
| Knowledge | Madulaa, Dainfanaad Cananata Churchuraa I | U. Chrysteinel Analysia I. U. Mashanina I. U. Conser | -t- Church uno - | | | |
| | Modules: Reinforced Concrete Structures I | +II, Structural Analysis I+II, Mechanics I+II, Concre | ate Structures | | | |
| Educational Objectives | After taking part successfully, students ha | ve reached the following learning results | | | | |
| Professional Competence | | | | | | |
| Knowledge | The students know the main bridge types, their applications and the various loads. They can explain the basic design method | | | | | |
| | They can explain the design of a prestressed bridge. | | | | | |
| CI-ill- | | | | | | |
| SKIIIS | The students are able to design reinforced or prestressed concrete bridges. | | | | | |
| Personal Competence | | | | | | |
| Social Competence | The students can design in teamwork a rea | al concrete bridge. | | | | |
| 4 | The students are able to design a prestressed concrete bridge and discuss the problems and results with other students. | | | | | |
| Αυτοποτηγ | The students are able to design a prestres | sed concrete bridge and discuss the problems and | i results with othe | r students. | | |
| Workload in Hours | Independent Study Time 110, Study Time | in Lecture 70 | | | | |
| Credit points | 6 | | | | | |
| Course achievement | None | | | | | |
| Examination | Written exam | | | | | |
| Examination duration and | 180 minutes | | | | | |
| scale | | | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural | Engineering: Compulsory | | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory | | | | | |
| | Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory | | | | | |
| | Civil Engineering: Specialisation Computational Engineering: Elective Compulsory | | | | | |
| | International Management and Engineering | | | | | |

| Course L0603: Design of Pre | stressed Structures and Concreet Bridges |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | NN |
| Language | DE |
| Cycle | SoSe |
| Content | prestressed structures |
| | basis of prestressed structures, field of application differences between reinforced and prestressed concrete structures history of prestressing construction materials: concrete, tendons, ducts, anchorage systems construction: prestressing methods prestressing forces and member forces (friction, elongation) tendon layout time dependant prestressing losses design of prestressed structures design of anchorage region non-bonded prestressing prestressed flat slabs |
| | Concrete bridges history of bridges design of bridges loads on bridges loads on bridges member forces for slab, T-beam, hollow box, frame and arch bridges precast bridges - precast segmental bridges bearings abutments, columns construction methods damages - checking of bridges |
| Literature | Vorlesungsumdruckim STUDiP Rombach, G. (2003): Spannbetonbau. Ernst & Sohn, Berlin Wicke, M. (2002): Anwendung des Spannbetons. Betonkalender 2002, Teil II, S. 113-180, Verlag Ernst & Sohn, Berlin Leonhardt, F. (1980): Vorlesungen über Massivbau. Teil 5: Spannbeton. Berlin Mehlhorn, G. (2007): Handbuch Brücken, Springer Verlag Schäfer, H.; Kaufeld, K. (1997): Massivbrücken. Betonkalender Teil II, S. 443ff, Ernst & Sohn, Berlin Menn, Ch. (1986): Stahlbetonbrücken. Springer Verlag, Wien |

| Course L0604: Design of Pre | ourse L0604: Design of Prestressed Structures and Concreet Bridges | |
|-----------------------------|--|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | NN | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|--------------------------------------|---|---|--------|----|
| Title | | Тур | Hrs/wk | СР |
| Digital Twinning in Civil Engineerin | g (L3136) | Lecture | 2 | 2 |
| Digital Twinning in Civil Engineerin | g (L3137) | Seminar | 2 | 4 |
| Module Responsible | Alexander Chmelnizkij | | | |
| 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 Tim | ne in Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Presentation | | | |
| Examination duration and | 20 min presentation and 5 pages hando | ut | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Compute | tational Engineering: Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Coastal | Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Geotec | hnical Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Structu | ral Engineering: Elective Compulsory | | |

| Course L3136: Digital Twinning in Civil Engineering | |
|---|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Alexander Chmelnizkij, Prof. Bastian Oesterle, Prof. Kay Smarsly |
| Language | DE |
| Cycle | SoSe |
| Content | |
| Literature | |

| Course L3137: Digital Twinning in Civil Engineering | |
|---|--|
| Тур | Seminar |
| Hrs/wk | 2 |
| СР | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Alexander Chmelnizkij, Prof. Bastian Oesterle, Prof. Kay Smarsly |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Module M0827: Mode | ling in Water Management | | | |
|---|---|---|-----------------|-----------------------|
| | , | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Groundwater Modeling using Modfle | | Lecture | 1 | 1 |
| Groundwater Modeling using Modfle Modeling of Water Supply Network | | Recitation Section (small) Project-/problem-based Learning | 2 2 | 2 3 |
| Module Responsible | | roject-problem-based Learning | 2 | 5 |
| Admission Requirements | | | | |
| Recommended Previous | | | | |
| Knowledge | oroundwatch | | | |
| | groundwater hydraulics and transport of s | ubstances | | |
| | Pipe Systems | | | |
| | Knowledge on urban water infrastructur | es, in particular drinking water systemsand | urban drainag | je systems includin |
| | special structures | | - | |
| | Hydraulics of drinking water supply system | ns and sewer systems | | |
| | Basic knowledge on water management | | | |
| Educational Objectives | After taking part successfully, students have rea | ched the following learning results | | |
| Professional Competence | | - • | | |
| Knowledge | The students are able to describe the modelling | of groundwater flow and transport as well as ur | ban water infra | astructures. They ca |
| | carry out systems analyses and can detect tech | nical and conceptual weak points within the sy | stems in case | studies. Besides the |
| | are able to analyse interdependencies of hydrau | lic and toxic phenomena in soil and water. | | |
| | | | | |
| | | | | |
| Skills | The students are able to construct and apply so | cientific groundwater models indipendently. Th | ey can work o | n different scenarios |
| | and can compare or assess different solutions for | r existing problems by application of selected s | oftware produ | cts. The students are |
| | able to use different software solutions (e.g. EPA | NET, EPA-SWMM). | | |
| | | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| • | Wird nicht vermittelt. | | | |
| | | | | |
| Autonomy | Wird nicht vermittelt. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lec | cure 70 | | |
| Credit points | | | | |
| Course achievement | None | | | |
| Examination | | | | |
| | 30 min | | | |
| scale | | | | |
| - | Civil Engineering: Specialisation Structural Engin | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical En | | | |
| | Civil Engineering: Specialisation Coastal Engineer | • • • | | |
| | Civil Engineering: Specialisation Water and Traff | | | |
| | Civil Engineering: Specialisation Computational E Water and Environmental Engineering: Specialis | | | |
| | Water and Environmental Engineering: Specialis Water and Environmental Engineering: Specialis | | | |
| | Water and Environmental Engineering: Specialis | | | |
| | the state state state and state sta | | | |

| Course L0543: Groundwater | Modeling using Modflow |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Sonja Götz |
| Language | DE/EN |
| Cycle | SoSe |
| Content | Introduction and application of the groundwater model MODFLOW (PMWIN); theoretical backround of the modell, students do work |
| | with the model PMWIN for practical case studies. |
| Literature | MODFLOW-Handbuch |
| | Chiang, Wen Hsien: PMWIN |
| | |

| Course L0544: Groundwater | urse L0544: Groundwater Modeling using Modflow | | |
|---------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Sonja Götz | | |
| Language | DE/EN | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Course L0875: Modeling of Water Supply Network | | |
|--|--|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Dr. Klaus Johannsen | |
| Language | DE | |
| Cycle | SoSe | |
| Content | | |
| Literature | Mutschmann/Stimmelmayr: Taschenbuch der Wasserversorgung, 16. Auflage. Springer Vieweg - Verlag. Wiesbaden 2014. | |

| Courses | | | | |
|-------------------------------------|--|---|--------------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Soil Mechanics - Selected Topics (L | 0374) | Lecture | 2 | 2 |
| Soil Dynamics (L0452) | | Lecture | 2 | 2 |
| Experimental Researches in Geote | hnics (L0706) | Practical Course | 2 | 2 |
| Module Responsible | Prof. Jürgen Grabe | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Modules: Mathematics I-III, Mechanics I-II, Ge | otechnics I | | |
| Knowledge | Courses: Soil laboratory course, (Applied stru | ictural dynamics) | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students will be able to, | | | |
| | describe wave propagation in the ground under dynamic excitation and define the relevant parameters, to measure vibrations and to interpret the data obtained with regard to their effect on people and structures, justify when elastodynamic methods are sufficient and when plastodynamic effects must be taken into account, to reproduce the collapse theorems of plasticity theory, describe the viscous behavior of cohesive soils and computationally account for creep deformation and rate-dependent shear strengths as well as to determine the effect of partial saturation on the seepage flow and the shear strength. | | | |
| Skills | After the successful completion of the module the students should be able to: | | | |
| | to derive and apply the basic equation | of a simple mass oscillator. | | |
| | | n the soil under dynamic excitation and to | detect the relevant par | ameters, |
| | | ield tests to determine soil dynamic chara | | |
| | to design machine foundations to dyn | amic load, | | |
| | to measure shocks to perform vibration | n forecast, | | |
| | to evaluate shocks in terms of their ef | fect on people and buildings, | | |
| | to evaluate possibilities of isolation, | | | |
| | to understand mechanisms that cause | earthquakes and evaluate earthquakes ir | n terms of their magnitu | ide and intensity, |
| | to know methods to determine axial p | ile capacity, integrity, and the dynamic be | dding modulus, | |
| | to know the mechanisms that lead to mathematically, | a deformation accumulation due to cyclic | loading and to estimat | e these deformatio |
| | to distinguish the area of application of | of the method of elastodynamics and plast | odynamics, | |
| | to detect the undrained shear strength | n as a function of a number of state variab | les, | |
| | calculations, | nesive soils and to consider the effects of | creep and rate-depend | ent shear strength |
| | to consider the impact of the partly sa | turated of a seepage and shear strength. | | |
| Personal Competence | | | | |
| Social Competence | Students will be able to work in teams to ad | chieve results on measurement and expe | rimental principles and | present their resu |
| | together at the end of the semester. | | | |
| Autonomy | Students are able to assess their own streng | ths and weaknesses and organize their tin | ne and learning manage | ement based on thi |
| Workload in Hours | Independent Study Time 96, Study Time in L | ecture 84 | | |
| Credit points | 6 | | | |
| Course achievement | Compulsory Bonus Form | Description | | |
| | Yes None Subject theoretical practical work | and | | |
| Examination | Written exam | | | |
| | | | | |
| Examination duration and scale | 135 min | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering | ngineering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnica | | | |
| . showing curricula | Civil Engineering: Specialisation Coastal Engi | | | |
| | Civil Engineering: Specialisation Computation | | | |

| Course L0374: Soil Mechanic | s - Selected Topics |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Hans Mathäus Stanford |
| Language | DE |
| Cycle | SoSe |
| Content | selected topis: |
| Literature | Stress-strain behaviour (experiments, observations, models) Hydraulic behaviour (experiments, observations, models) Physical modelling (similarity theory, 1g model tests, ng model tests) Limit and safety analysis (collapse theorems of plasticity theory, upper and lower bound analysis, limit equilibrium analysis, numerical analysis) Heat transport (heat conduction, convective heat transport, freezing/thawing) Kolymbas D. (2019): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. Springer Verlag, 5. Auflage Muir Wood D. (2004). Geotechnical modelling. CRC Press Nova, R. (2010). Soil mechanics. Wiley Verruijt, A. (2012). Soil mechanics. u r l: https://geo.verruijt.net Verruijt A. (2018). An introduction to soil mechanics. Vol. 30, Springer Series Theory and Applications of Transport in Porous Media |
| | |

| Course L0452: Soil Dynamics | | |
|-----------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Anne Hagemann | |
| Language | DE | |
| Cycle | SoSe | |
| Content | • mass-spring-damper systems, | |
| | • wave propagation in soils, | |
| | • dynamic soil parameters, | |
| | • Determination of dynamic soil parameters, | |
| | • machine foundations, | |
| | • in-situ measurement of ground motion, ground motion prediction, evaluation of ground motion, | |
| | • ground motion shielding, | |
| | introduction into earthquake engineering, | |
| | • dynamic pile tests, | |
| | • cyclic accumulation, | |
| | • plastodynamics | |
| Literature | Das B.M.: Fundamentals of Soil Dynamics, Elsevier Empfehlungen des Arbeitskreises Baugrunddynamik. Hrsg. Deutsche Gesellschaft für Geotechnik (DGGT) Haupt W.: Bodendynamik. Vieweg und Teubner Meskouris K. und Hinzen KG.: Bauwerke und Erdbeben. Vieweg Verlag Studer J.A., Koller M.G. und Laue J.: Bodendynamik, Springer Verlag | |

| Course L0706: Experimental | Researches in Geotechnics |
|----------------------------|---|
| Тур | Practical Course |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Hans Mathäus Stanford, Göta Bürkner |
| Language | DE |
| Cycle | SoSe |
| Content | The students are supposed to: become acquainted with geotechnical model tests, field tests and laboratory tests as well as corresponding measurement techniques. These compromise amongst others inclinometer measurements and geophone measurements as well as high-grade laboratory tests on the stress-strain relationship of soil specimens, e. g. triaxial tests, simple shear tests and resonant column tests. gain insight into current soil mechanical research. plan, coordinate, perform and evaluate soil mechanical tests in a team. discuss, reflect, review and present the obtained results in a group. An important learning target is the introduction to scientific work for students who plan a scientific career, and for those who will work in practice with the responsibility to order corresponding tests and evaluate the results. The practical laboratory work is based on annualy changing problems, which are however related to the experience and results of the preceding year's course group. |
| Literature | Grabe, J. (2004): Bodenmechanik und Grundbau, Band 3 der Veröffentlichungsreihe des Instituts für Geotechnik und Baubetrieb, Technische Universität Hamburg-Harburg. Kolymbas, D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. 2., korrigierte und ergänzte Auflage, Springer Verlag. Normen zu geotechnischen Versuchsgeräten und Versuchsverfahren: DIN 18135:2012-04: Baugrund, Untersuchung von Bodenproben - Eindimensionaler Kompressionsversuch, Deutsches Institut für Normung, e. V. DIN 18137-2:2011-04: Baugrund, Untersuchung von Bodenproben - Bestimmung der Scherfestigkeit - Teil 2: Triaxialversuch, Deutsches Institut für Normung e. V. |

| Courses | | | | |
|--|---|------------------------------------|-----------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Noise Protection (L1109) | | Lecture | 2 | 2 |
| Urban Infrastructures (L0874) | | Project-/problem-based Learning | 2 | 4 |
| Module Responsible | Dr. Dorothea Rechtenbach | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | Knowledge on Urban planning | | | |
| | Knowledge on measures for climate protection | | | |
| | General knowledge of scientific writing/working | | | |
| Educational Objectives | After taking part successfully, students have reached the following | g learning results | | |
| Professional Competence | | | | |
| Knowledge | Students can describe urban development corridors as well as cu | rrent and future urban environr | mental probler | ns. They are able |
| | explain the causes of environmental problems (like noise). Students can specify applications for various technical innovations and explain why these contribute to the improvement | | | |
| | | | | provement of urb |
| | life. They can, for example, derive and discuss measures for effective noise abatement. | | | |
| Skills Students are able to develop specific solutions for correcting existing or future environment-related p | | problems of urb | | |
| Skins | development. They can define a range of conceptual and technical solutions for environmental problems for different d | | | |
| | paths. To solve specific urban environmental problems they can | | | |
| | context. | | 5 | |
| Personal Competence | | | | |
| Social Competence | The students can work together in international groups. | | | |
| Autonomy | Students are able to organize their work flow to prepare themse | luce for presentations and cont | ributions to th | o discussions. Th |
| Autonomy | | | | le discussions. In |
| | can acquire appropriate knowledge by making enquiries independ | ienuy. | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | Written Report plus oral Presentation | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Elective C | Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Electiv | ve Compulsory | | |
| | Civil Engineering: Specialisation Coastal Engineering: Elective Cor | npulsory | | |
| | Civil Engineering: Specialisation Water and Traffic: Elective Comp | ulsory | | |
| | Environmental Engineering: Core Qualification: Elective Compulso | ry | | |
| | Joint European Master in Environmental Studies - Cities and Susta | inability: Core Qualification: Cor | mpulsory | |
| | Logistics, Infrastructure and Mobility: Specialisation Infrastructure | and Mobility: Elective Compuls | ory | |
| | Water and Environmental Engineering: Specialisation Environmen | t: Elective Compulsory | | |
| | Water and Environmental Engineering: Specialisation Environment Water and Environmental Engineering: Specialisation Cities: Comp | | | |

| Course L1109: Noise Protect | ion |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Martin Jäschke |
| Language | EN |
| Cycle | SoSe |
| Content | |
| Literature | 1) Müller & Möser (2013): Handbook of Engineering Acoustics (also available in German) |
| | 2) WHO (1999): Guidelines for Community Noise |
| | 3) Environmental Noise Directive 2002/49/EG |
| | 4) ISO 9613-2 (1996): Acoustics, Attenuation of sound during propagation outdoors, Part 2: General method of calculation |

| Course L0874: Urban Infrast | ructures |
|-----------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 2 |
| СР | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Dr. Dorothea Rechtenbach |
| Language | EN |
| Cycle | SoSe |
| Content | Problem Based Learning Main topics are: • Central vs. Decentral Wastewater Treatment. • Compaction of Cities. |
| | Car Free Cities. Multifunctional Places in Cities. The Sustainability of Freight Transport in Cities. |
| Literature | Depends on chosen topic. |

| Courses | | | | |
|-------------------------------------|---|---|---------------|---------------------|
| Title | | Тур | Hrs/wk | СР |
| Harbour Engineering (L0809) | | Lecture | 2 | 2 |
| Harbour Engineering (L1414) | | Project-/problem-based Learning | 1 | 2 |
| Port Planning and Port Construction | n (L0378) | Lecture | 2 | 2 |
| Module Responsible | Prof. Peter Fröhle | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basics of coastal engineering | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the for | bllowing learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are able to define in details and to choose design approaches for the functional design of a port and apply then | | | |
| | design tasks. They can design the fundamental elements of a port. | | | |
| CL 111 | The students are able to select and apply appropriate approaches for the functional design of ports. | | | |
| SKIIIS | The students are able to select and apply appropriate appr | baches for the functional design of po | rts. | |
| Personal Competence | | | | |
| Social Competence | The students are able to deploy their gained knowledge i | n applied problems such as the funct | tional design | of ports. Additiona |
| | they will be able to work in team with engineers of other di | sciplines. | | |
| Autonomy | The students will be able to independently extend their known | wledge and apply it to new problems | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | The duration of the examination is 150 min. The examin | ation includes tasks with respect to | the general u | understanding of |
| scale | lecture contents and calculations tasks. | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Ele | ctive Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: | Elective Compulsory | | |
| | Civil Engineering: Specialisation Coastal Engineering: Comp | pulsory | | |
| | Civil Engineering: Specialisation Water and Traffic: Elective | Compulsory | | |
| | International Management and Engineering: Specialisation | II. Civil Engineering: Elective Computs | orv | |

| Course L0809: Harbour Engineering | |
|-----------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Peter Fröhle |
| Language | DE |
| Cycle | SoSe |
| Content | Fundamentals of harbor engineering Maritime transportation and waterways engineering Ships Elements of harbors Harbor approaches and water-side harbor areas Terminal design and handling of cargo Quay-walls and piers Equipment of harbors Sluices and other special constructions Connection to inland transportation / inland waterway transportation Protection of harbors Breakwaters and Jetties Wave protection of harbors Fishery and other small harbors |
| Literature | Brinkmann, B.: Seehäfen, Springer 2005 |

| Course L1414: Harbour Engi | urse L1414: Harbour Engineering | |
|----------------------------|---|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Peter Fröhle | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Hrs/wk 2 CP 2 | |
|----------------------|---|
| | |
| Vendelaged in Llaure | 2 |
| Vorkioad in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Frank Feindt |
| Language | DE |
| Cycle | SoSe |
| Content | Planning and implementation of major projects Market analysis and traffic relations Planning process and plan Port planning in urban neighborhood Development of the logistics center "Port of Hamburg" in the metropolis Quays and waterfront structure Special planning Law Harbor - securing of a flexible use of the port Dimensioning of quays Flood protection structures Port of Hamburg - Infrastructure and development Preparation of areas Scour formation in front of shore structures |

| Courses | | | | |
|-------------------------------------|--|--------------------------------------|---------------------|---------------------|
| Title | | Түр | Hrs/wk | СР |
| Hydraulic Models (L0813) | | Project-/problem-based Learning | 1 | 1 |
| Modelling of Waves (L0812) | | Project-/problem-based Learning | 1 | 1 |
| Modelling of Flow in Rivers and Est | uaries (L0810) | Lecture | 3 | 4 |
| Module Responsible | Prof. Peter Fröhle | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Coastal Hydraulic Engineering I | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the following part successfully and the students have reached the following part successfully and the students have reached the students have been successfully as the students have reached the students have been successfully as the stude | owing learning results | | |
| Professional Competence | | | | |
| Knowledge | Knowledge Students are able to define in detail the basic processes that are related to the modelling of flows in hydraulic | | ydraulic engineerir | |
| | Besides, they can describe the basic aspects of numerical modelling and actual numerical models for the simulation of flows an | | | |
| | waves. | | | |
| Skills | Students are able to apply hydrodynamic-numerical models t | o practical hydraulic engineering ta | ckc | |
| JKIIIS | Students are able to apply hydrodynamic-numerical models to practical hydraulic engineering tasks. | | | |
| Personal Competence | | | | |
| Social Competence | The students are able to deploy their gained knowledge in si | mple applied problems. Additionaly | , they will be | able to work in tea |
| | with others. | | | |
| Autonomy | The students will be able to independently extend their know | ledge and apply it to new problems | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | The duration of the examination is 3 hours. The examination | on includes tasks with respect to | the general ι | understanding of t |
| scale | lecture contents and calculations tasks. | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Elect | ve Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: El | ective Compulsory | | |
| | Civil Engineering: Specialisation Coastal Engineering: Elective | Compulsory | | |
| | Civil Engineering: Specialisation Computational Engineering: | | | |

| Course L0813: Hydraulic Mod | dels |
|-----------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Peter Fröhle |
| Language | DE/EN |
| Cycle | SoSe |
| Content | Fundamentals of hydraulic models Model laws Pi theorem of Buckingham Practical examples of hydraulic models |
| Literature | Strobl, Zunic: Wasserbau, Kap. 11 Hydraulische Modelle, Springer |

| Course L0812: Modelling of | Waves |
|----------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Peter Fröhle |
| Language | DE/EN |
| Cycle | SoSe |
| Content | Waves, interactions with shallow water and constructions Wave theories Sea state and surges Development of waves Wave spectra Modelling of Waves / phase averaged and phase resolved models Application of a phase averaged model for wave prediction (SWAN) Application of phase resolved wave models (Mike) |
| Literature | Vorlesungsumdruck |

| Course L0810: Modelling of I | |
|------------------------------|--|
| | Lecture |
| Hrs/wk | |
| СР | 4 |
| | Independent Study Time 78, Study Time in Lecture 42 |
| | Prof. Edgar Nehlsen, Prof. Peter Fröhle |
| Language | |
| Cycle | SoSe Introduction to numerical flow modelling |
| | Processes affecting tht flow Examples and applications of numerical models Procedure of numerical modelling Model concept Basic equations of hydrodynamics Saint-Venant equations Euler Equations Navier-Stokes equations Reynolds-averaged Navier-Stokes equations Shallow water equations |
| | Solving schemes • Numerical discretization • Solution algorithms • Convergence |
| Literature | Vorlesungsskript |
| | Bund der Ingenieure für Wasserwirtschaft, Abfallwirtschaft und Kulturbau (1997): Hydraulische Berechnung von naturnaher Fließgewässern. Düsseldorf: BWK (BWK-Merkblatt). Chow, Ven-te (1959): Open-channel Hydraulics. New York usw.: McGraw-Hill (McGraw-Hill Civil Engineering Series). Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (DWA); DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische Modelle, DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische (2019a): Merkblatt DWA-M 543-2 Geodaten in der Fließgewässermodellierung Teil 1: Geodaten in der Fließgewässermodellierung. Februar 2019. Hennef: Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall (DWA-Regelwerk, 543-1). |
| | Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (DWA); DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische Modelle, DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische (2019b): Merkblatt DWA-M 543-2 Geodaten in de Fließgewässermodellierung Teil 2: Bedarfsgerechte Datenerfassung und -aufbereitung. Februar 2019. Hennef: Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall (DWA-Regelwerk, 543-2). |
| | Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (DWA); DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische Modelle, DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische (2019c): Merkblatt DWA-M 543-3 Geodaten in de Fließgewässermodellierung - Teil 3: Aspekte der Strömungsmodellierung und Fallbeispiele. Februar 2019. Hennef: Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall (DWA-Regelwerk, 543-3). |
| | Hervouet, Jean-Michel (2007): Hydrodynamics of free surface flows. Modelling with the finite element method. Chichester: Wiley Online verfügbar unter http://www.loc.gov/catdir/enhancements/fy0741/2007296953-b.html. |
| | IAHR (2015): Professional Specifications for Physical and Numerical Studies in Environmental Hydraulics. In: Hydrolink (3/2015), 5 90-92. |
| | Olsen, Nils Reidar B. (2012): Numerical Modelling and Hydraulics. 3. Aufl. Department of Hydraulic and Environmental Engineering The Norwegian University of Science and Technology. |
| | Szymkiewicz, Romuald (2010): Numerical modeling in open channel hydraulics. Dordrecht: Springer (Water science an technology library, 83). |
| | van Waveren, Harold (1999-): Good modelling practice handbook. [Utrecht], Lelystad, Den Haag: STOWA; Rijkswaterstaat-RIZA SDU, afd. SEO/RIZA [etc. distr.] (Nota, nr. 99.036). |
| | Zielke, Werner (Hg.) (1999): Numerische Modelle von Flüssen, Seen und Küstengewässern. Deutscher Verband fü Wasserwirtschaft und Kulturbau. Bonn: Wirtschafts- und VerlGes. Gas und Wasser (Schriftenreihe des Deutschen Verbandes fü Wasserwirtschaft und Kulturbau, 127). |

| Courses | | | | |
|--|---|---|---------------------|---------------------|
| Title | | Тур | Hrs/wk | СР |
| Biological Wastewater Treatment (I | | Lecture | 2 | 2 |
| Biological Wastewater Treatment (I | | Recitation Section (la | 5 | 1 |
| Advanced Wastewater Treatment (| | Lecture | 2 arge) 1 | 2 |
| Advanced Wastewater Treatment (| • | Recitation Section (Ia | arge) I | 1 |
| Module Responsible Admission Requirements | None | | | |
| | | and the key processes involved in wastewat | er treatment | |
| Knowledge | knowledge of wastewater management | and the key processes involved in wastewat | er treatment. | |
| 3 | After taking part successfully, students h | ave reached the following learning results | | |
| Professional Competence | Alter taking part successiony, students i | ave reached the following learning results | | |
| - | Students are able to outline key areas o | f the full range of treatment systems in was | to water management | s well as their mut |
| Knowledge | | f the full range of treatment systems in was ction. They can describe relevant economic, | | |
| | dependence for sustainable water protei | tion. They can describe relevant economic, | | riactors. |
| Skills | Students are able to pre-design and explain the available wastewater treatment processes and the scope of their application | | | |
| | municipal and for some industrial treatm | ent plants. | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Social skills are not targeted in this mod | ule. | | |
| Autonomy | Students are in a position to work on a subject and to organize their work flow independently. They can also present on th | | | |
| | subject. | | | |
| | | | | |
| | Independent Study Time 96, Study Time | In Lecture 84 | | |
| Credit points Course achievement | | | | |
| Examination | | | | |
| Examination duration and | | | | |
| scale | 120 mm | | | |
| | Civil Engineering: Specialisation Structur | al Engineering: Elective Compulsory | | |
| Following Curricula | | | | |
| Tonowing curricula | Civil Engineering: Specialisation Coastal | | | |
| | Civil Engineering: Specialisation Water a | • • • • | | |
| | | - General Bioprocess Engineering: Elective (| Compulson | |
| | | on Water Quality and Water Engineering: Elective | | |
| | | ing: Specialisation II. Process Engineering and | | e Compulsory |
| | | ing: Specialisation II. Energy and Environme | | |
| | | ronmental Process Engineering: Elective Cor | | compulsory |
| | Process Engineering: Specialisation Proc | | npuisory | |
| | Water and Environmental Engineering: S | | | |
| | • • | pecialisation Environment: Elective Compuls | sorv | |
| | | pecialisation environment. Elective compute | | |

| Course L0517: Biological Wastewater Treatment | | |
|---|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Dr. Joachim Behrendt | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | Charaterisation of Wastewater | |
| | Metobolism of Microorganisms | |
| | Kinetic of mirobiotic processes | |
| | Calculation of bioreactor for wastewater treatment | |
| | Concepts of Wastewater treatment | |
| | Design of WWTP | |
| | Excursion to a WWTP | |
| | Biofilms | |
| | Biofim Reactors | |
| | Anaerobic Wastewater and sldge treatment | |
| | resources oriented sanitation technology | |
| | Future challenges of wastewater treatment | |
| Literature | Gujer, Willi | |
| | Siedlungswasserwirtschaft : mit 84 Tabellen | |
| l | | |

| ISBN: 3540343296 (Gb.) URL: http://www.gbv.de/dms/bs/toc/516261924.pdf URL: http://deposit.d-nb.de/cgi-bin/dokserv? |
|---|
| id=2842122&prov=M&dok_var=1&dok_ext=htm |
| Berlin [u.a.] : Springer, 2007 |
| TUB_HH_Katalog |
| Henze, Mogens |
| Wastewater treatment : biological and chemical processes |
| ISBN: 3540422285 (Pp.) |
| Berlin [u.a.] : Springer, 2002 |
| TUB_HH_Katalog |
| Imhoff, Karl (Imhoff, Klaus R.;) |
| Taschenbuch der Stadtentwässerung : mit 10 Tafeln |
| ISBN: 3486263331 ((Gb.)) |
| München [u.a.] : Oldenbourg, 1999 |
| TUB_HH_Katalog |
| Lange, Jörg (Otterpohl, Ralf; Steger-Hartmann, Thomas;) |
| Abwasser : Handbuch zu einer zukunftsfähigen Wasserwirtschaft |
| ISBN: 3980350215 (kart.) URL: http://www.gbv.de/du/services/agi/52567E5D44DA0809C12570220050BF25/000000700334 |
| Donaueschingen-Pfohren : Mall-Beton-Verl., 2000 |
| TUB_HH_Katalog |
| Mudrack, Klaus (Kunst, Sabine;) |
| Biologie der Abwasserreinigung : 18 Tabellen |
| ISBN: 382741427X URL: http://www.gbv.de/du/services/agi/94B581161B6EC747C1256E3F005A8143/420000114903 |
| Heidelberg [u.a.] : Spektrum, Akad. Verl., 2003 |
| TUB HH_Katalog |
| Tchobanoglous, George (Metcalf & Eddy, Inc., ;) |
| Wastewater engineering : treatment and reuse |
| ISBN: 0070418780 (alk. paper) ISBN: 0071122508 (ISE (*pbk)) |
| Boston [u.a.] : McGraw-Hill, 2003 |
| TUB_HH_Katalog |
| Henze, Mogens |
| Activated sludge models ASM1, ASM2, ASM2d and ASM3 |
| ISBN: 1900222248 |
| London : IWA Publ., 2002 |
| TUB_HH_Katalog |
| Kunz, Peter |
| Umwelt-Bioverfahrenstechnik |
| |
| Vieweg, 1992 |
| Bauhaus-Universität., Arbeitsgruppe Weiterbildendes Studium Wasser und Umwelt (Deutsche Vereinigung für |
| Wasserwirtschaft, Abwasser und Abfall, ;) |
| Abwasserbehandlung : Gewässerbelastung, Bemessungsgrundlagen, Mechanische Verfahren, Biologische Verfahren, Reststoffe |
| aus der Abwasserbehandlung, Kleinkläranlagen ISBN: 3860682725 URL: http://www.gbv.de/dms/weimar/toc/513989765_toc.pdf URL: |
| |
| http://www.gbv.de/dms/weimar/abs/513989765_abs.pdf |
| Weimar : Universitätsverl, 2006 |
| TUB_HH_Katalog |
| Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall |
| DWA-Regelwerk |
| Hennef : DWA, 2004 |
| TUB_HH_Katalog |
| Wiesmann, Udo (Choi, In Su; Dombrowski, Eva-Maria;) |
| Fundamentals of biological wastewater treatment |
| ISBN: 3527312196 (Gb.) URL: http://deposit.ddb.de/cgi-bin/dokserv?id=2774611&prov=M&dok_var=1&dok_ext=htm |
| Weinheim : WILEY-VCH, 2007 |
| TUB_HH_Katalog |
| |

| Course L3122: Biological Wa | ourse L3122: Biological Wastewater Treatment | |
|-----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dr. Joachim Behrendt | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L0357: Advanced Wa | stewater Treatment |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Joachim Behrendt |
| Language | |
| Cycle | SoSe |
| Content | Survey on advanced wastewater treatment |
| | reuse of reclaimed municipal wastewater |
| | Precipitation |
| | Flocculation |
| | Depth filtration |
| | Membrane Processes |
| | Activated carbon adsorption |
| | Ozonation |
| | "Advanced Oxidation Processes" |
| | Disinfection |
| Literature | Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003 |
| | Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987 |
| | Membranverfahren: Grundlagen der Modul- und Anlagenauslegung, T. Melin und R. Rautenbach, Springer-Verlag, Berlin 2007 |
| | Trinkwasserdesinfektion: Grundlagen, Verfahren, Anlagen, Geräte, Mikrobiologie, Chlorung, Ozonung, UV-Bestrahlung, |
| | Membranfiltration, Qualitätssicherung, W. Roeske, Oldenbourg-Verlag, München 2006 |
| | Organische Problemstoffe in Abwässern, H. Gulyas, GFEU, Hamburg 2003 |

| Course L0358: Advanced Was | stewater Treatment |
|----------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Joachim Behrendt |
| Language | EN |
| Cycle | SoSe |
| Content | Aggregate organic compounds (sum parameters) |
| | Industrial wastewater |
| | Processes for industrial wastewater treatment |
| | Precipitation |
| | Flocculation |
| | Activated carbon adsorption |
| | Recalcitrant organic compounds |
| | |
| Literature | Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003 |
| | Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987 |
| | Membranverfahren: Grundlagen der Modul- und Anlagenauslegung, T. Melin und R. Rautenbach, Springer-Verlag, Berlin 2007 |
| | Trinkwasserdesinfektion: Grundlagen, Verfahren, Anlagen, Geräte, Mikrobiologie, Chlorung, Ozonung, UV-Bestrahlung, Membranfiltration, Qualitätssicherung, W. Roeske, Oldenbourg-Verlag, München 2006 |
| | Organische Problemstoffe in Abwässern, H. Gulyas, GFEU, Hamburg 2003 |

| Courses | |
|--------------------------|--|
| Title | Typ Hrs/wk CP |
| City Planning (L1066) | Project-/problem-based Learning 4 6 |
| Module Responsible | |
| Admission Requirements | None |
| | for "Principles of Urban Planning": none |
| Knowledge | for "Designing Urban Streetscapes": some knowledge of transport planning, e.g. through taking the undergraduate class "Trar |
| | Planning and Traffic Engineering" |
| | |
| Educational Objectives | After taking part successfully, students have reached the following learning results |
| Professional Competence | |
| | Students are able to: |
| 5 | |
| | use technical terms of urban planning. |
| | describe the main determinants of urban development. evaluation and compare different persibilities of how urban development can be influenced. |
| | explain and compare different possibilities of how urban development can be influenced. discuss requirements for public streetscapes. |
| | explain the importance of street design. |
| | |
| | |
| Skills | Students are able to: |
| | e read and analyze when development concerts and designs for streetscanes |
| | read and analyze urban development concepts and designs for streetscapes appraise such concepts in the context of comparing requirements |
| | appraise such concepts in the context of competing requirements. design, justify and reflect their own solutions for concrete examples. |
| | |
| | |
| Personal Competence | |
| Social Competence | Students are able to: |
| | discuss intermediate results with each other. |
| | constructively accept feedback on their own work. |
| | provide constructive feedback to others. |
| | |
| | |
| Autonomy | Students are able to: |
| | independently complete a written report including drawings following a broadly pre-defined process. |
| | assess the consequences of their proposed solutions. |
| | independently acquire knowledge and apply this to new issues or problem areas. |
| | |
| | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Credit points | 6 |
| Course achievement | None |
| Examination | Written elaboration |
| Examination duration and | written assignment, designwork during the semester |
| scale | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Elective Compulsory |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory |
| | Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory |
| | Civil Engineering: Specialisation Water and Traffic: Elective Compulsory |
| | Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective Compulsory |
| | Water and Environmental Engineering: Specialisation Environment: Elective Compulsory Water and Environmental Engineering: Specialisation Cities: Compulsory |

| Course L1066: City Planning | |
|-----------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| CP | 6 |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Lecturer | Prof. Carsten Gertz |
| Language | DE |
| Cycle | SoSe |
| Content | "Principles of Urban Planning" deals with the determinants of urban development and their interactions. Topics include: legal framework, instruments and methods of planning, functional requirements, stakeholders and actors basic design requirements different planning levels and historical contexts. The objective of the course is for students to acquire a basic understanding of urban development problems and approaches for solving them. They will also be able to comprehend the process of urban planning. The course also covers the various functional and aesthetic requirements for designing streetscape as the most important elements of public space. The project work deals with a real life scenario and includes drawing up a development plan, an urban design concept, a building masterplan and a street redesign. |
| Literature | Albers, Gerd; Wekel, Julian (2021) Stadtplanung: Eine illustrierte Einführung. 4. überarbeitete Auflage. Primus Verlag. Darmstadt. Frick, Dieter (2011) Theorie des Städtebaus: Zur baulich-räumlichen Organisation von Stadt. 3. veränderte Auflage. Wasmuth Verlag. Tübingen Jonas, Carsten (2009) Die Stadt und ihr Grundriss. Wasmuth-Verlag. Tübingen Kostof, Spiro; Castillo, Greg (1998) Die Anatomie der Stadt. Geschichte städtischer Strukturen. Campus-Verlag. Frankfurt/New York. |

| Courses | | | | |
|---------------------------------|--|------------------------------------|---------------|----------------------|
| Title | Тур | | Hrs/wk | СР |
| Construction Logistics (L1163) | Lectu | | 1 | 2 |
| Construction Logistics (L1164) | | ation Section (small) | 1 | 2 |
| Project Development and Managen | | ure ect-/problem-based Learning | 1 | 1 |
| Project Development and Managen | | ct-/problem-based Learning | 1 | 1 |
| Module Responsible | | | | |
| Admission Requirements | | | | |
| Recommended Previous | none | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the following lea | arning results | | |
| Professional Competence | Chuda aha ang | | | |
| Knowleage | Students can | | | |
| | • give definitions of the main terms of construction logistics and | project development and m | anagement | |
| | name advantages and disadvantages of internal or external con | nstruction logistics | | |
| | • explain characteristics of products, demand and production of | construction objects and the | eir consequer | nces for constructio |
| | specific supply chains | | | |
| | differentiate constructions logistics from other logistics systems | 5 | | |
| Skille | Students can | | | |
| JKIIIS | | | | |
| | carry out project life cycle assessments | | | |
| | apply methods and instruments of construction logistics | | | |
| | apply methods and instruments of project development and management | | | |
| | apply methods and instruments of conflict management | | | |
| | design supply and waste removal concepts for a construction p | roject | | |
| Personal Competence | | | | |
| Social Competence | Students can | | | |
| boerar competence | | | | |
| | hold presentations in and for groups | | | |
| | apply methods of conflict solving skills in group work and case | studies | | |
| Διιτοποπγ | Students can | | | |
| hatohomy | | | | |
| | solve problems by holistic, systemic and flow oriented thinking | | | |
| | improve their creativity, negotiation skills, conflict and crises | solution skills by applying | methods of | moderation in cas |
| | studies | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | Written elaboration | | | |
| | Two written papers with presentations | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Elective Comp | pulsory | | |
| Following Curricula | Civil Engineering: Specialisation Sedecular Engineering: Elective Configuration Sedecular Engineering: Elective Co | 5 | | |
| string curriculu | Civil Engineering: Specialisation Coastal Engineering: Elective Comput | | | |
| | Civil Engineering: Specialisation Water and Traffic: Elective Compulso | • | | |
| | International Management and Engineering: Specialisation II. Civil Eng | | ory | |
| | International Management and Engineering: Specialisation II. Logistics | | | |
| | | | | |
| | Logistics, Infrastructure and Mobility: Specialisation Production and Lo | aistics: Elective Compulsory | / | |

| Course L1163: Construction | Logistics |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Heike Flämig |
| Language | DE |
| Cycle | SoSe |
| Content | The lecture gives deeper insight how important logistics are as a competetive factor for construction projects and which issues are to be adressed. The following toppics are covered: competetive factor logistics the concept of systems, planning and coordination of logistics material, equipment and reverse logistics IT in construction logistics elements of the planning model of construction logistics and their connections flow oriented logistics systems for construction projects logistics concepts for ready to use construction projects (especially procurement and waste removel logistics) best practice examples (construction logistics Potsdamer Platz, recent case study of the region) Contents of the lecture are deepened in special exercises. |
| Literature | Flämig, Heike: Produktionslogistik in Stadtregionen. In: Forschungsverbund Ökologische Mobilität (Hrsg.) Forschungsbericht Bd 15.2. Wuppertal 2000. Krauss, Siri: Die Baulogistik in der schlüsselfertigen Ausführung, Bauwerk Verlag GmbH Berlin 2005. Lipsmeier, Klaus: Abfallkennzahlen für Neubauleistungen im Hochbau : Verlag Forum für Abfallwirtschaft und Altlasten, 2004. Schmidt, Norbert: Wettbewerbsfaktor Baulogistik. Neue Wertschöpfungspotenziale in der Baustoffversorgung. In: Klaus, Peter Edition Logistik. Band 6. Deutscher Verkehrs-Verlag. Hamburg 2003. Seemann, Y.F. (2007): Logistikkoordination als Organisationseinheit bei der Bauausführung Wissenschaftsverlag Mainz in Aachen, Aachen. (Mitteilungen aus dem Fachgebiet Baubetrieb und Bauwirtschaft (Hrsg. Kuhne, V.): Heft 20) |

| Course L1164: Construction | Course L1164: Construction Logistics | |
|----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Heike Flämig | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| ourse L1161: Project Development and Management | | |
|---|--|--|
| Тур | Lecture | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Heike Flämig, Dr. Anton Worobei | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Within the lecture, the main aspects of project development and management are tought: | |
| | Terms and definitions of project management | |
| | Advantages and disadvantages of different ways of project handling | |
| | organization, information, coordination and documentation | |
| | cost and fincance management in projects | |
| | time- and capacity management in projects | |
| | specific methods and instruments for successful team work | |
| | Contents of the lecture are deepened in special exercises. | |
| Literature | Projektmanagement-Fachmann. Band 1 und Band 2. RKW-Verlag, Eschborn, 2004. | |

| Course L1162: Project Devel | rse L1162: Project Development and Management | |
|-----------------------------|---|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Heike Flämig, Dr. Anton Worobei | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Module M0998: Statio | s and Dynamics of Structure | es | | |
|---|---|--|-------------------|--------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Structural Dynamics (L1202) | | Lecture | 2 | 2 |
| Structural Dynamics (L1203) | | Recitation Section (large) | 2 | 2 |
| Fracture mechanics and fatigue in | steel structures (L0564) | Lecture | 1 | 1 |
| Fracture mechanics and fatigue in | steel structures (L0565) | Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof. Bastian Oesterle | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Knowledge of linear structural analysis | of statically determinate and indeterminate structu | ures; Mechanics | I/II, Mathematics |
| | Differential equations I | | | |
| Educational Objectives | After taking part successfully, students h | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After successful completion of this mod respective methods. | ule, the student can explain the basic aspects of d | ynamic effects c | n structures and 1 |
| Skills | After successful completion of this mo dynamics loading using the appropriate o | odule, the students will be able to predict the res computational approaches and methods. | ponse of materi | al and structures |
| Personal Competence | | | | |
| Social Competence | Students can | | | |
| | | | | |
| | participate in subject-specific and | | | |
| | defend their own work results in fr | | | |
| | promote the scientific developmer | - | | |
| | Furthermore, they can give and ac | ccept professional constructive criticism | | |
| Autonomy | Students are able to gain knowledge of t | he subject area from given and other sources and a | oply it to new pr | oblems. Furthermo |
| | | ocess for problems in the area of Structural Analysis. | | |
| | | | | |
| | Independent Study Time 96, Study Time | in Lecture 84 | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | Written exam | | | |
| Examination duration and | 150 min | | | |
| scale | | | | |
| | Civil Engineering: Specialisation Structure | al Engineering: Compulsory | | |
| Assignment for the | Civil Engineering: Specialisation Geotech | nical Engineering: Elective Compulsory | | |
| Assignment for the Following Curricula | | | | |
| - | Civil Engineering: Specialisation Coastal | Engineering: Elective Compulsory | | |
| - | Civil Engineering: Specialisation Coastal Civil Engineering: Specialisation Water ar | | | |
| - | | nd Traffic: Elective Compulsory | | |

| Course L1202: Structural Dy | namics | |
|-----------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Bastian Oesterle | |
| Language | DE | |
| Cycle | SoSe | |
| Content | mechanical background of dynamics harmonic vibrations, damped and undamped free and forced vibrations frequency and time domain modelling aspects principle of d'Alembert systems with multiple degrees of freedom consistent and lumped mass matrices finite elements for dynamics problems impact problems eigenvalue problems and modal analysis direct time integration schemes, transient analyses | |
| Literature | Vorlesungsmanuskript Clough, R.W., Penzien, J.: Dynamics of Structures. 2. Aufl., McGraw-Hill, New York, 1993. | |

| Course L1203: Structural Dy | ourse L1203: Structural Dynamics | |
|-----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Bastian Oesterle | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Тур | Lecture |
|-------------------|--|
| Hrs/wk | 1 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Jürgen Priebe |
| Language | DE |
| Cycle | SoSe |
| Content | basics of fatigue stress and fatigue resistance and determination of fatigue strength, |
| | determination and use of S-N-curves and classification of notch effects, |
| | • set up of determination of fatigue strength under dynamic load using the accumulation formula by Palmgren-Miner, |
| | set up of determination of fatigue strength in different examples, |
| | basics of construction and design regarding the problem of material fatigue, |
| | basics of linear elastic fracture mechanics under static and dynamic load, |
| | determination of lifetime of steel construction based on linear elastic fracture mechanics in different examples. |
| Literature | Seeßelberg, C.; Kranbahnen - Bemessung und konstruktive Gestaltung; 3. Auflage; Bauwerk-Verlag; Berlin 2009 |
| | • Kuhlmann, Dürr, Günther; Kranbahnen und Betriebsfestigkeit; in Stahlbau Kalender 2003; Verlag Ernst & Sohn; Berlin 2003 |
| | Deutscher Stahlbau-Verband (Hrsg.); Stahlbau Handbuch Band 1 Teil B; 3. Auflage; Stahlbau-Verlagsgesellschaft; Köln 199 |
| | Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993 |
| | DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsree Bemessungsregeln für den Hochbau; 1993 |
| | • DIN V ENV 1993-6: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 6: Kranbahnen; 2001 |
| | DIN-Fachbericht 126. Richtlinie zur Anwendung von DIN V ENV 1993-6; Nationales Anwendungsdokument (NAD); Berlin 20 |
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| Course L0565: Fracture mechanics and fatigue in steel structures | |
|--|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Jürgen Priebe |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Courses | | | | |
|------------------------------------|---|--|---------|----|
| Гitle | | Тур | Hrs/wk | СР |
| Steel Construction Project (L1206) | | Project Seminar | 4 | 6 |
| Module Responsible | Prof. Marcus Rutner | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Steel and Composite Structures | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students ha | ve reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to prepare a part of the | whole project and explain it to the others. | | |
| Skills | 5 Students can produce sketches and calculations of their part of the project. They are able to adjust their work in reaction | | | |
| | changing conditions resulting from other p | participants of the project. | | |
| Personal Competence | | | | |
| Social Competence | Students can present their results to othe | r members of the group. | | |
| | They have the ability to work for a broad a | agreement with respect to intergroup depende | encies. | |
| | They can distribute and process tasks inde | ependently. | | |
| Autonomy | Students can handle their part of the proje | ect on their own resposibility- | | |
| Workload in Hours | Independent Study Time 124, Study Time | in Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | approx. 15-20 pages (without appendix) | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Geotechn | ical Engineering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Coastal E | ngineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Structura | | | |
| | Civil Engineering: Specialisation Computation | ional Engineering: Elective Compulsory | | |

| Course L1206: Steel Construction Project | |
|--|---|
| Тур | Project Seminar |
| Hrs/wk | 4 |
| СР | 6 |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Lecturer | Prof. Marcus Rutner |
| Language | DE |
| Cycle | SoSe |
| Content | Design of a big construction project (i.e skyscraper, large bridge, roof of a stadiuim) in small groups |
| Literature | Wird je nach Projekt individuell angegeben. |

| Courses | | | | |
|---|--|---|---------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Marine Geotechnics (L0548) | | Lecture | 1 | 2 |
| Marine Geotechnics (L0549) | | Recitation Section (large) | 2 | 2 |
| Steel Structures in Foundation and Module Responsible | | Lecture | Z | Ζ |
| Admission Requirements | | | | |
| | Complete modules: Geotechnics I-III, Math | ematics LIII | | |
| Kecommended Previous Knowledge | complete modules: Geotechnics I-III, Math | | | |
| Knowledge | Courses: Soil laboratory course | | | |
| Educational Objectives | After taking part successfully, students have reached the following learning results | | | |
| Professional Competence | | | | |
| Knowledge | The students get a deeper knowledge of s | steel and ground engineering as well as construct | ions knowledge co | oncerning quay wa |
| | Furthermore, the students get all the necessary knowledge to design singular construction elements for sheet pile walls and they | | | |
| know how to choose the right construction elements depending on the influencing conditions. | | | | |
| Skille | Furthermore, the students are able to dir | nension sheet nile wall construction regarding al | l construction eler | ments to choose t |
| Skiiis | Furthermore, the students are able to dimension sheet pile wall construction regarding all construction elements, to choose the suitable construction elements with respect to the influencing conditions, to design all kinds of sheet pile walls (wave sheet pile | | | |
| | walls and combined sheet pile walls) and to dimension all construction elements and connections. | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | Students are able to assess their own stre | ngths and weaknesses and organize their time an | d learning manage | ement based on thi |
| 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 | Civil Engineering: Specialisation Geotechn | ical Engineering: Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Structural | Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Coastal E | ngineering: Compulsory | | |
| | Civil Engineering: Specialisation Computat | ional Engineering: Elective Compulsory | | |
| | | | | |

| Course L0548: Marine Geote | Course L0548: Marine Geotechnics | |
|----------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Jürgen Grabe | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Geotechnical investigation an description of the seabed Foundations of Offshore-Constructions cCliff erosion Sea dikes Port structures Flood protection structures | |
| Literature | EAK (2002): Empfehlungen für Küstenschutzbauwerke EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke Poulos H.G. (1988): Marine Geotechnics. Unwin Hyman, London Wagner P. (1990): Meerestechnik: Eine Einführung für Bauingenieure. Ernst & Sohn, Berlin | |

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| Course L0549: Marine Geote | irse L0549: Marine Geotechnics | |
|----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Jürgen Grabe | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L1146: Steel Structures in Foundation and Hydraulic Engineering | | |
|--|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Frank Feindt | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Design of a sheet pile wall, design of a combined sheet pile wall, piles, walings, connections, fatigue | |
| Literature | EAU 2012, EA-Pfähle, EAB | |

| C | | | | |
|--|--|--|-------------------|-------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Smart Monitoring (L2762) Smart Monitoring (L2763) | | Integrated Lecture Recitation Section (small) | 2 | 2 4 |
| Module Responsible | Prof. Kay Smarsly | Rectation Section (Small) | L | - |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge or interest in object-oriented mode | aling programming and concor technology | aios ara halaful | Interact in mo |
| Knowledge | research and teaching areas, such as Internet of Th | | | |
| j- | skills of scientific working, are required. Basic knowle | | | |
| | | | | |
| | After taking part successfully, students have reached | the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students will become familiar with the princip | | | |
| | decentralized smart systems to be applied for co | | | |
| | environment. In addition, the students will learn to d | | | |
| | analysis techniques, modern software design concep | | | |
| | also part of this module, which will be conducted throughout the semester and will contribute to the grade. In small groups, students will design smart monitoring systems that integrate a number of "intelligent" sensors to be implemented by the stude | | | |
| | Specific focus will be put on the application of machine learning techniques. The smart monitoring systems will be mounted | | | |
| | real-world (built or natural) systems, such as bridges or slopes, or on scaled lab structures for validation purposes. The outcome | | | |
| | every group will be documented in a paper. All stude | | | |
| | system in the annual "Smart Monitoring" competition | | | |
| | will be taught in English. Limited enrollment. | | | 5 |
| | | | | |
| Skills | The students will gain insights into operating state-o | of-the-art smart sensor systems, used for | monitoring a wi | de range of phy |
| | processes relevant to engineering, such as environ | nmental, structural, or comfort monitori | ng. The students | s will be capabl |
| | devising monitoring strategies of physical processes as part of group projects, tailored to their knowledge backgrounds, and | | | |
| | implement the strategies in smart wireless sensor no | • • • • | ogramming. Fina | lly, the students |
| | be able to document the findings of their projects in s | short reports. | | |
| Personal Competence | | | | |
| Social Competence | tence The students will be able to work in groups, share parts of the work for their projects, and develop communication skills, to | | | |
| | achieving the common project goals. | | | |
| 4 | | | | |
| Autonomy | The students will be able to gain a solid basis on a | | ineering, as well | as on documer |
| | results, through their involvement in their monitoring | group projects. | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture | 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| | 10 pages of work with 15-minute oral presentation | | | |
| scale | Civil Engineering: Considiration Water and Traffic El | | | |
| - | Civil Engineering: Specialisation Water and Traffic: El Civil Engineering: Specialisation Geotechnical Engine | | | |
| Following Curricula | Civil Engineering: Specialisation Coastal Engineering: | | | |
| | Civil Engineering: Specialisation Structural Engineering. | | | |
| | Computer Science: Specialisation II: Intelligence Engi | | | |
| | Environmental Engineering: Specialisation Energy an | | | |
| | Environmental Engineering: Specialisation Environme | | | |
| | Environmental Engineering: Specialisation Water Quality and Water Engineering: Elective Compulsory | | | |
| | Mechatronics: Technical Complementary Course: Elec | | . , | |
| | Mechatronics: Core Qualification: Elective Compulsor | | | |
| | Theoretical Mechanical Engineering: Specialisation Re | | ompulsory | |
| | Water and Environmental Engineering: Specialisation | | . , | |
| | | | | |
| | Water and Environmental Engineering: Specialisation | Environment: Elective Compulsory | | |

| Course L2762: Smart Monito | ring |
|----------------------------|--|
| Тур | Integrated Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Kay Smarsly |
| Language | EN |
| Cycle | SoSe |
| Content | In this course, principles of smart monitoring will be taught, focusing on modern concepts of data acquisition, data storage, and data analysis. Also, fundamentals of intelligent sensors and embedded computing will be illuminated. Autonomous software and decentralized data processing are further crucial parts of the course, including concepts of the Internet of Things, Industry 4.0 and cyber-physical systems. Furthermore, measuring principles, data acquisition systems, data management and data analysis algorithms will be discussed. Besides the theoretical background, numerous practical examples will be shown to demonstrate how smart monitoring may advantageously be used for assessing the condition of systems in the built or natural environment. |
| Literature | The course contents couples different fields, such as signal processing, sensing technologies, data analytics, environmental engineering, civil engineering, artificial intelligence, database systems, and many more. The basics will be taught in this course. However, specific literature that covers all these topics does not exist. Instead, literature will be referenced in the lectures, all of which are papers that are freely available online. |

| Course L2763: Smart Monito | ring |
|----------------------------|---|
| | Recitation Section (small) |
| Hrs/wk | |
| СР | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. Kay Smarsly |
| Language | EN |
| Cycle | SoSe |
| | The contents of the exercises are based on the lecture contents. In addition to the exercises, project work will be conducted throughout the semester, which will consume the majority of the workload. As part of the project work, students will design smart monitoring systems that will be tested in the laboratory or in the field. As mentioned in the module description, the students will participate in the "Smart Monitoring" competition, hosted annually by the Institute of Digital and Autonomous Construction. Students are encouraged to contribute their own ideas. The tools required to implement the smart monitoring systems will be taught in the group exercises as well as through external sources, such as video tutorials and literature. The course contents couples different fields, such as signal processing, sensing technologies, data analytics, environmental engineering, civil engineering, artificial intelligence, database systems, and many more. The basics will be taught in this course. |
| | However, specific literature that covers all these topics does not exist. Instead, literature will be referenced in the lectures, all of which are papers that are freely available online. |

| Module M1845: Thin- | walled structures | | | |
|--------------------------------|---|--|--------------------|---------------------------------------|
| | | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Thin-walled structures (L1199) | | Lecture | 2 | 3 |
| Thin-walled structures (L3045) | | Recitation Section (large) | 2 | 3 |
| Module Responsible | Prof. Bastian Oesterle | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | | | | |
| | Structural Analysis II | | | |
| | Finite Element Methods | | | |
| Educational Objectives | After taking part successfully, students have read | ched the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After successful completion of this module, the | students can express the basic aspects of | the load-carryin | g behaviour of thi |
| | walled structures. | | | |
| <i>CL 11</i> | | and the second | | · · · · · · · · · · · · · · · · · · · |
| Skills | After successful completion of this module, the | | g benaviour of th | nin-walled structure |
| | using appropriate analytical and coputational me | thods. | | |
| Personal Competence | | | | |
| Social Competence | Students can | | | |
| | participate in subject-specific and interdisc | ciplinary discussions, | | |
| | • defend their own work results in front of o | thers | | |
| | promote the scientific development of coll | eagues | | |
| | Furthermore, they can give and accept pro | • | | |
| | | | | |
| Autonomy | Students are able to gain knowledge of the subje | - | | |
| | they are able to structure the solution process fo | r problems in the area of modelling and analy | sis of thin-walled | d structures. |
| Workload in Hours | Independent Study Time 124, Study Time in Lect | ure 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Engineer | ring: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Eng | gineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Computational E | ngineering: Compulsory | | |
| | Civil Engineering: Specialisation Structural Engine | eering: Elective Compulsory | | |
| | Theoretical Mechanical Engineering: Specialisatic | on Simulation Technology: Elective Compulso | ry | |

| Тур | Lecture | |
|-------------------|--|--|
| Hrs/wk | | |
| CP | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| | Prof. Bastian Oesterle | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Plates loaded in-plane | |
| | Governing equations (equilibrium, kinematics, constitutive law) | |
| | Differential equation | |
| | Airy stress function | |
| | Plane stress / plane strain | |
| | Structural behaviour of plates loaded in-plane | |
| | finite elements for plates loaded in-plane, modelling apsects, interpretation and critical assessment of results | |
| | Plates in bending | |
| | | |
| | Governing equations (equilibrium, kinematics, constitutive law) | |
| | Differential equation | |
| | Navier solution / Fourier series expansion | |
| | Approximation procedures | |
| | Circular and rectangular plates Structural hebraicaus of plates in hearding | |
| | Structural behaviour of plates in bending | |
| | finite elements for plates in bending, modelling apsects, interpretation and critical assessment of results | |
| | Shells | |
| | Phenomenona of the structural behaviour of shells | |
| | Membrane and bending theory | |
| | Equilibrium equations of shells of revolution | |
| | Stress resultants and deformations of the spherical shell, the half spherical shell, and the cylindrical shell | |
| | finite elements for shells | |
| | Stability problems (overview) | |
| | | |
| | Plate buckling Chall buckling | |
| | Shell buckling | |
| | | |
| Literature | Vorlesungsmanuskript | |
| | Vollesungsmanuskript Basar, Y.: Krätzig, W.B. (1985): Mechanik der Flächentragwerke. Vieweg-Verlag, Braunschweig, Wiesbaden | |
| | | |
| | Girkmann, K. (1963): Flächentragwerke, Springer Verlag, Wien, 1963, unveränderter Nachdruck 1986 Zienkiewicz, O.C. (1977): The Einite Element Mathed in Engineering Science, McGraw Hill, London | |
| | • Zienkiewicz, O.C. (1977): The Finite Element Method in Enginieering Science. McGraw-Hill, London | |
| | | |

| Course L3045: Thin-walled st | purse L3045: Thin-walled structures | |
|------------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| CP | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Bastian Oesterle | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| | tal Hydraulic Engineering I | | | |
|------------------------------------|---|--|---------------------|---------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Basics of Coastal Engineering (L08 | | Lecture | 3 | 4 |
| Basics of Coastal Engineering (L14 | | Project-/problem-based Learr | ning 1 | 2 |
| Module Responsible | Prof. Peter Fröhle | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basics of hydraulic engineering, hydrolog | y and hydromechanics | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students h | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are able to define and expla | ain the basic concepts of coastal engineering and p | ort engineering. T | hey are able to app |
| | the concepts to selected practical problems of coastal engineering. Students can define and determine the basics for design and | | | |
| | dimensioning of coastal engineering cons | structions. | | |
| Skills | The students are capable to apply basic design approaches to selected and pre-defined design tasks in coastal engineering. | | | |
| Personal Competence | | | | |
| Social Competence | The students are able to deploy their ga | ained knowledge in applied problems such as the c | lesign of coastal p | protection structur |
| | Additionaly, they will be able to work in te | eam with engineers of other disciplines, for instance | e designing of coa | stal breakwaters. |
| Autonomy | The students will be able to independent | ly extend their knowledge and applyit to new proble | ems. | |
| 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 | The duration of the examination is 2 ho | ours. The examination includes tasks with respec | t to the general (| understanding of t |
| scale | lecture contents and calculations tasks. | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal B | Engineering: Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotech | nical Engineering: Compulsory | | |
| | Civil Engineering: Specialisation Structura | al Engineering: Elective Compulsory | | |
| | Environmental Engineering: Specialisatio | n Environment and Climate: Elective Compulsory | | |
| | Environmental Engineering: Specialisatio | n Water Quality and Water Engineering: Elective Co | mpulsory | |
| | International Management and Engineering | ng: Specialisation II. Civil Engineering: Elective Com | pulsory | |
| | Water and Environmental Engineering: Sp | pecialisation Environment: Elective Compulsory | | |
| | Water and Environmental Engineering: Sp | pecialisation Water: Elective Compulsory | | |

| Course L0807: Basics of Coas | Course L0807: Basics of Coastal Engineering | | |
|------------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 3 | | |
| CP | 4 | | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | | |
| Lecturer | Prof. Peter Fröhle | | |
| Language | EN | | |
| Cycle | SoSe | | |
| Content | | | |
| | Basics of planning and design | | |
| | Water levels Currents | | |
| | Waves | | |
| | o lce | | |
| | Planning and Design in Coastal Engineering | | |
| | Functional and constructional design | | |
| | Determination of design parameters | | |
| | Design-approaches | | |
| | Filter | | |
| | Rubble mound constructions | | |
| | Piles | | |
| | Vertical constructions | | |
| | | | |
| | | | |
| Literature | Coastal Engineering Manual, CEM | | |
| | Vorlesungsumdruck | | |
| | | | |
| | | | |
| | | | |

| Course L1413: Basics of Coas | urse L1413: Basics of Coastal Engineering | |
|------------------------------|---|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Peter Fröhle | |
| Language | EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|-----------------------------------|--|--|-----------------|------------------|
| Title | | Тур | Hrs/wk | СР |
| Offshore Geotechnical Engineering | (L0067) | Lecture | 1 | 1 |
| Hydro Power Use (L0013) | | Lecture | 1 | 1 |
| Wind Turbine Plants (L0011) | | Lecture | 2 | 3 |
| Wind Energy Use - Focus Offshore | L0012) | Lecture | 1 | 1 |
| Module Responsible | Dr. Marvin Scherzinger | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Module: Technical Thermodynamics I, | | | |
| Knowledge | Module: Technical Thermodynamics II, | | | |
| | Module: Fundamentals of Fluid Mechanics | | | |
| Educational Objectives | After taking part successfully, students have reach | ned the following learning results | | |
| Professional Competence | | | | |
| | By ending this module students can explain in detail knowledge of wind turbines with a particular focus of wind energy use offshore conditions and can critical comment these aspects in consideration of current developments. Furthermore, they are a to describe fundamentally the use of water power to generate electricity. The students reproduce and explain the basic proced in the implementation of renewable energy projects in countries outside Europe. | | | |
| | Through active discussions of various topics with application of the theoretical background and are to | | | iderstanding and |
| Skills | s Students are able to apply the acquired theoretical foundations on exemplary water or wind power systems and evaluate a assess technically the resulting relationships in the context of dimensioning and operation of these energy systems. They can compare critically the special procedure for the implementation of renewable energy projects in countries outside Europe with t in principle applied approach in Europe and can apply this procedure on exemplary theoretical projects. | | | |
| Personal Competence | | | | |
| Social Competence | Students can discuss scientific tasks subjet-specif | icly and multidisciplinary within a s | eminar. | |
| Autonomy | Students can independently exploit sources in the context of the emphasis of the lecture material to clear the contents of t lecture and to acquire the particular knowledge about the subject area. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lectur | re 70 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 180 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Enginee | ering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engi | ineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory | | | |
| | International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory | | | |
| | International Management and Engineering: Specialisation II. Renewable Energy: Elective Compulsory | | | |
| | Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory | | | |
| | Product Development, Materials and Production: S | | ompulsory | |
| | | pecialisation Production: Elective C | | |
| | Product Development, Materials and Production: S | • | mpulsory | |
| | Product Development, Materials and Production: S Renewable Energies: Core Qualification: Compulso | pecialisation Materials: Elective Cor | mpulsory | |
| | | pecialisation Materials: Elective Cor pry | | |
| | Renewable Energies: Core Qualification: Compulso | pecialisation Materials: Elective Cor pry h Energy Systems: Elective Compuls | sory | |
| | Renewable Energies: Core Qualification: Compulso Theoretical Mechanical Engineering: Specialisation | pecialisation Materials: Elective Cor yry h Energy Systems: Elective Compuls l Process Engineering: Elective Com | sory | |
| | Renewable Energies: Core Qualification: Compulso Theoretical Mechanical Engineering: Specialisation Process Engineering: Specialisation Environmental | pecialisation Materials: Elective Cor yry a Energy Systems: Elective Compuls Process Engineering: Elective Com ion Cities: Elective Compulsory | sory pulsory | |

| ourse L0067: Offshore Geot | technical Engineering | |
|----------------------------|--|--|
| Тур | ecture | |
| Hrs/wk | | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dr. Jan Dührkop | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Overview and Introduction Offshore Geotechnics Introduction to Soil Mechanics Offshore soil investigation Focus on cyclical effects Geotechnical design of offshore foundations Monopiles Jackets Heavyweight foundations Geotechnical preliminary exploration for the use of lift boats and platforms | |
| Literature | Randolph, M. and Gourvenec, S (2011): Offshore Geotechnical Engineering. Spon Press. Poulos H.G. (1988): Marine Geotechnics. Unwin Hyman, London BSH-Standard Baugrunderkundung für Offshore-Windenergieparks Lesny K. (2010): Foundations for Offshore Wind Turbines. VGE Verlag, Essen. EA-Pfähle (2012): Empfehlungen des Arbeitskreises Pfähle der DGGT. Ernst & Sohn, Berlin. | |

| Course L0013: Hydro Power | Use |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Stefan Achleitner |
| Language | DE |
| Cycle | SoSe |
| Content | Introduction, importance of water power in the national and global context Physical basics: Bernoulli's equation, usable height of fall, hydrological measures, loss mechanisms, efficiencies Classification of Hydropower: Flow and Storage hydropower, low and high pressure systems Construction of hydroelectric power plants: description of the individual components and their technical system interaction Structural engineering components; representation of dams, weirs, dams, power houses, computer systems, etc. Energy Technical Components: Illustration of the different types of hydraulic machinery, generators and grid connection Hydropower and the Environment Examples from practice |
| Literature | Schröder, W.; Euler, G.; Schneider, K.: Grundlagen des Wasserbaus; Werner, Düsseldorf, 1999, 4. Auflage Quaschning, V.: Regenerative Energiesysteme: Technologie - Berechnung - Simulation; Carl Hanser, München, 2011, 7. Auflage Giesecke, J.; Heimerl, S.; Mosony, E.: Wasserkraftanlagen - Planung, Bau und Betrieb; Springer, Berlin, Heidelberg, 2009, 5. Auflage von König, F.; Jehle, C.: Bau von Wasserkraftanlagen - Praxisbezogene Planungsunterlagen; C. F. Müller, Heidelberg, 2005, 4. Auflage Strobl, T.; Zunic, F.: Wasserbau: Aktuelle Grundlagen - Neue Entwicklungen; Springer, Berlin, Heidelberg, 2006 |

| Course L0011: Wind Turbine | Plants |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Dr. Rudolf Zellermann |
| Language | DE |
| Cycle | SoSe |
| Content | Historical development Wind: origins, geographic and temporal distribution, locations Power coefficient, rotor thrust Aerodynamics of the rotor Operating performance Power limitation, partial load, pitch and stall control Plant selection, yield prediction, economy Excursion |
| Literature | Gasch, R., Windkraftanlagen, 4. Auflage, Teubner-Verlag, 2005 |

| Course L0012: Wind Energy | Use - Focus Offshore |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 1 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Martin Skiba |
| Language | DE |
| Cycle | SoSe |
| Content | Introduction, importance of offshore wind power generation, Specific requirements for offshore engineering Physical fundamentals for utilization of wind energy Design and operation of offshore wind turbines, presentation of different concepts of offshore wind turbines, representation of the individual system components and their system-technical relationships Foundation engineering, offshore site investigation, presentation of different concepts of offshore foundation structures, planning and fabrication of foundation structures Electrical infrastructure of an offshore wind farm, Inner Park cabling, offshore substation, grid connection Installation of offshore wind farms, installation techniques and auxiliary devices, construction logistics Development and planning of offshore wind farms Operation and optimization of offshore wind farms Day excursion |
| Literature | Gasch, R.; Twele, J.: Windkraftanlagen - Grundlagen, Entwurf, Planung und Betrieb; Vieweg + Teubner, Stuttgart, 2007, 7. Auflage Molly, J. P.: Windenergie - Theorie, Anwendung, Messung; C. F. Müller, Heidel-berg, 1997, 3. Auflage Hau, E.: Windkraftanlagen; Springer, Berlin, Heidelberg, 2008, 4.Auflage Heier, S.: Windkraftanlagen - Systemauslegung, Integration und Regelung; Vieweg + Teubner, Stuttgart, 2009, 5. Auflage Jarass, L.; Obermair, G.M.; Voigt, W.: Windenergie: Zuverlässige Integration in die Energieversorgung; Springer, Berlin, Heidelberg, 2009, 2. Auflage |

| Courses | | | | | |
|---------------------------------|---|--|-----------------------|--------------------|--|
| Title | | Turn | Line /usiz | CD | |
| Water Protection and Wastewater | Aanagement (10226) | Typ Lecture | Hrs/wk 3 | СР 3 | |
| Water Protection and Wastewater | - | Project Seminar | 3 | 3 | |
| Module Responsible | Prof. Ralf Otterpohl | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | | | | | |
| Knowledge | Basic knowledge in water managemen | t; | | | |
| | Good knowledge in urban drainage; Good knowledge of wastewater treatment techniques; | | | | |
| | Good knowledge of pollutants (e.g. CO | | | | |
| | | | | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | The students can describe the basic principle | • • | | • | |
| | They can explain limnological processes, su | | | | |
| | problems related to water protection, such | | atment with a special | focus on innovati | |
| | solutions, remediation measures as well as c | inceptual approaches. | | | |
| Skills | Students can accurately assess current prob | lems and situations in a country-specific or | local context. They o | can suggest concre | |
| | actions to contribute to the planning of tomorrow's urban water cycle. Furthermore, they can suggest appropriate technica | | | | |
| | administrative and legislative solutions to sol | ve these problems. | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| Personal Competence | | | | | |
| | The students can work together in internation | nal groups. | | | |
| , | 5 | 5 | | | |
| | | | | | |
| | | | | | |
| 4 1 1 1 1 1 | | | - | | |
| Autonomy | Students are able to organize their work flow | v to prepare presentations and discussions | . They can acquire ap | propriate knowled | |
| | by making enquiries independently. | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| Workload in Hours | Independent Study Time 96, Study Time in L | ecture 84 | | | |
| Credit points | | | | | |
| Course achievement | | | | | |
| Examination | Presentation | | | | |
| Examination duration and | Term paper plus presentation | | | | |
| scale | | | | | |
| | | | | | |
| | Civil Engineering: Specialisation Structural Er | 5 5 1 5 | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnica Civil Engineering: Specialisation Coastal Engi | | | | |
| | Civil Engineering: Specialisation Coastal Engi Civil Engineering: Specialisation Water and T | | | | |
| | Environmental Engineering: Specialisation Water and T | | e Compulsory | | |
| | International Management and Engineering: | | | | |
| | Water and Environmental Engineering: Speci | | | | |
| | Water and Environmental Engineering: Speci | | | | |
| | Water and Environmental Engineering: Speci | | | | |

| Course L0226: Water Protect | tion and Wastewater Management |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Prof. Ralf Otterpohl |
| Language | EN |
| Cycle | WiSe |
| | The lecture focusses on: Regulatory Framework (e.g. WFD) Main instruments for the water management and protection In depth knowledge of relevant measures of water pollution control Urban drainage, treatment options in different regions on the world Rainwater management, improved management of heavy rainfalls, downpours, rainwater harvesting, rainwater infiltration Case Studies and Field Trips |
| Literature | The literature listed below is available in the library of the TUHH. Water and wastewater technology Hammer, M. J. 1., & . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International. Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011). New York, NY: McGraw-Hill. Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ. |

| Course L2008: Water Protect | Course L2008: Water Protection and Wastewater Management | |
|-----------------------------|--|--|
| Тур | Project Seminar | |
| Hrs/wk | 3 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | |
| Lecturer | Prof. Ralf Otterpohl | |
| Language | EN | |
| Cycle | WiSe | |
| Content | | |
| Literature | | |

| Courses | | | | |
|-------------------------------------|---|---|-------------------|---------------------|
| Title | | Тур | Hrs/wk | СР |
| Examination of Materials, Structura | - | Lecture | 3 | 4 |
| Examination of Materials, Structura | | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Frank Schmidt-Döhl | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge about building materials or ma | aterial science, for example by the mod | ule Building Ma | terials and Buildin |
| Knowledge | Chemistry. | | | |
| Educational Objectives | After taking part successfully, students have reach | ed the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are able to describe the rules for tra methods for the testing of building material proper testing methods. | • • • | | |
| Skills | The students are able to responsibly discover the rules for trading and using of building products in Germany. They are able to chose suitable methods for the testing and inspection of construction products, the examination of damages a the examination of the structural conditions of buildings. They are able to conclude from symptons to the cause of damages. The are able to describe an examination in form of a test report or expert opinion. | | | |
| Personal Competence | The students can describe the different roles of m | anufacturers as well as testing supervisor | v and certificati | on bodies within t |
| Social competence | framework of material testing. They can describe th | ÷ . | - | |
| Autonomy | The students are able to make the timing and the o | peration steps to learn the specialist knowl | edge of a very e | xtensive field. |
| Workload in Hours | Independent Study Time 124, Study Time in Lectur | e 56 | | |
| Credit points | 6 | | | |
| Course achievement | | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Enginee | ring: Elective Compulsory | | |
| Following Curricula | | | | |
| - | Civil Engineering: Specialisation Coastal Engineerin | g: Elective Compulsory | | |
| | Civil Engineering: Specialisation Water and Traffic: | Elective Compulsory | | |
| | International Management and Engineering: Specia | lisation II. Civil Engineering: Elective Comp | ulsory | |
| | Materials Science and Engineering: Specialisation E | ngineering Materials: Elective Compulsory | | |
| | Materials Science: Specialisation Engineering Mater | rials: Elective Compulsory | | |

| Course L0260: Examination of | Course L0260: Examination of Materials, Structural Condition and Damages | | |
|------------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 3 | | |
| СР | 4 | | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | | |
| Lecturer | Prof. Frank Schmidt-Döhl | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Materials testing and marking process of construction products, testing methods for building materials and structures, testing | | |
| | reports and expert opinions, describing the condition of a structure, from symptons to the cause of damages | | |
| Literature | Frank Schmidt-Döhl: Materialprüfung im Bauwesen. Fraunhofer irb-Verlag, Stuttgart, 2013. | | |

| Course L0261: Examination of | Course L0261: Examination of Materials, Structural Condition and Damages | | |
|------------------------------|--|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 1 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Prof. Frank Schmidt-Döhl | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| | | 25 | | | | |
|--|--|---|---|--|--------------------|--------------------|
| Courses | | | | | | |
| litle . | | | т | Тур | Hrs/wk | СР |
| Concrete Structures (L0579) | | | | Seminar | 1 | 1 |
| Structural Concrete Members (L05 | (7) | | L | ecture | 2 | 3 |
| Structural Concrete Members (L05 | /8) | | R | ecitation Section (large) | 2 | 2 |
| Module Responsible | NN | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Basics of structural | analysis, conception a | nd dimensioning of struc | tural concrete | | |
| Knowledge | | | | | | |
| | Modules: Reinforced | d Concrete Structures I | +II, Structural Analysis I- | +II, Mechanics I+II | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Educational Objectives | After taking part su | iccessfully students ha | ve reached the following | learning results | | |
| Professional Competence | , iter taking part ba | iccostany, stadents na | ie reached the following | i carring results | | |
| | The students broad | lon their skills in struct | | ally in the field of buildings | (houses roofs ha | alls) They dispose |
| Knowledge | | | | and structural members t | | |
| | the knowledge for t | the conception and des | ight of concrete buildings | | | |
| Skills | The students are able to apply procedures of the conception and dimensioning to to practical problems of structural engineering | | | | | |
| | They are capable to draft concrete buildings and to design them for general action effects and to | | | | ects and to plan | their detailing a |
| | execution. Moreover, they can make design and construction sketches and draw up technical descriptions. | | | | | |
| Demonal Commetence | | | | | | |
| Personal Competence | | | | | | |
| | | | | | | |
| Social Competence | The students are ab | Die to obtain results of . | nigh quality in teamwork | | | |
| | | | | sioning tasks of structures | under the guidance | e of tutors. |
| Autonomy | The students are ab | ble to carry out comple: | x conception and dimens | | under the guidand | e of tutors. |
| Autonomy | The students are ab | | x conception and dimens | | under the guidanc | e of tutors. |
| Autonomy | The students are ab Independent Study 6 | ble to carry out comple: Time 110, Study Time | x conception and dimens | | under the guidanc | e of tutors. |
| Autonomy Workload in Hours | The students are ab Independent Study 6 Compulsory Bonus | ble to carry out comple: Time 110, Study Time Form | x conception and dimens in Lecture 70 Description | sioning tasks of structures | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement | The students are ab Independent Study 6 Compulsory Bonus No None | ble to carry out comple: Time 110, Study Time | x conception and dimens in Lecture 70 Description | | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination | The students are ab Independent Study 6 Compulsory Bonus No None Written exam | ble to carry out comple: Time 110, Study Time Form | x conception and dimens in Lecture 70 Description | sioning tasks of structures | under the guidanc | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and | The students are ab Independent Study 6 Compulsory Bonus No None Written exam | ble to carry out comple: Time 110, Study Time Form | x conception and dimens in Lecture 70 Description | sioning tasks of structures | under the guidanc | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination | The students are ab Independent Study 6 Compulsory Bonus No None Written exam | ble to carry out comple: Time 110, Study Time Form | x conception and dimens in Lecture 70 Description | sioning tasks of structures | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale | The students are ab Independent Study 6 Compulsory Bonus No None Written exam 120 minutes | ble to carry out comple: Time 110, Study Time Form Presentation | x conception and dimens in Lecture 70 Description | sioning tasks of structures | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | The students are ab Independent Study 6 Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Sp | ble to carry out comple: Time 110, Study Time Form Presentation Specialisation Structural | x conception and dimens in Lecture 70 Description Es werden 2 Re | sioning tasks of structures | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | The students are ab Independent Study 6 Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Sp Civil Engineering: Sp | ble to carry out comple: Time 110, Study Time Form Presentation Specialisation Structural Specialisation Geotechn | x conception and dimens in Lecture 70 Description Es werden 2 Re Engineering: Compulsor | sioning tasks of structures | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | The students are ab Independent Study 6 Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Sp Civil Engineering: Sp Civil Engineering: Sp | ble to carry out comple: Time 110, Study Time Form Presentation Specialisation Structural Specialisation Geotechn Specialisation Coastal En | x conception and dimens in Lecture 70 Description Es werden 2 Re Engineering: Compulsor ical Engineering: Elective | sioning tasks of structures eferate ausgegeben ry e Compulsory ipulsory | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | The students are ab Independent Study 6 Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Sp Civil Engineering: Sp Civil Engineering: Sp Civil Engineering: Sp Civil Engineering: Sp | ble to carry out complex Time 110, Study Time Form Presentation Specialisation Structural Specialisation Geotechn Specialisation Coastal Er Specialisation Water and | x conception and dimens in Lecture 70 Description Es werden 2 Re Engineering: Compulsor ical Engineering: Elective ngineering: Elective Com | sioning tasks of structures eferate ausgegeben ry e Compulsory ipulsory lsory | under the guidand | e of tutors. |

| Course L0579: Concrete Stru | ictures |
|-----------------------------|---|
| Тур | Seminar |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | NN |
| Language | DE |
| Cycle | WiSe |
| Content | With help of a project teamwork the subjects of the course "Concrete Structures" is practiced, discussed and presented. |
| Literature | - Projektbezogene Unterlagen werden abgegeben. |

| Course L0578: Structural Co | ncrete Members |
|-----------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | NN |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Courses | | | | | | |
|------------------------------------|---|---|----------------------|--------------------|--|--|
| Title | | Тур | Hrs/wk | СР | | |
| Chemistry of Drinking Water Treatr | nent (L0311) | Lecture | 2 | 1 | | |
| Chemistry of Drinking Water Treatr | | Recitation Section (large) | 1 | 2 | | |
| Water Resource Management (L04 | | Lecture | 2 | 2 | | |
| Water Resource Management (L04 |)3) | Recitation Section (small) | 1 | 1 | | |
| Module Responsible | Prof. Mathias Ernst | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Knowledge of water management and the | ne key processes involved in water treatment. | | | | |
| Knowledge | | | | | | |
| Educational Objectives | After taking part successfully, students h | nave reached the following learning results | | | | |
| Professional Competence | | | | | | |
| Knowledge | Students will be able to outline key are | eas of conflict in water management, as well as th | neir mutual depend | dence for sustaina | | |
| | water supply. They will understand rele | evant economic, environmental and social factors | . Students will be | able to explain a | | |
| | outline the organisational structures of v | water companies. They will be able to explain the a | vailable water trea | atment processes | | |
| | outline the organisational structures of water companies. They will be able to explain the available water treatment processes and the scope of their application. | | | | | |
| | the scope of their application. | | | | | |
| Skills | Students will be able to assess com | plex problems in drinking water production ar | id establish solut | ions involving w | | |
| | management and technical measures. They will be able to assess the evaluation methods that can be used for this. Students w | | | | | |
| | be able to carry out chemical calculati | ons for selected treatment processes and apply | generally accepted | d technical rules | | |
| | standards to these processes. | | | | | |
| | | | | | | |
| Personal Competence | | | | | | |
| Social Competence | Working in a diverse group of specialist | s, students will be able to develop and document | complex solutions | for the managem | | |
| | and treatment of drinking water. They will be able to take an appropriate professional position, for example representing us | | | | | |
| | interests. They will be able to develop jo | int solutions in teams of diverse experts and prese | nt these solutions t | to others. | | |
| Autonomy | Students will be in a partition to work on | a subject independently and present on this subject | + | | | |
| Autonomy | Students will be in a position to work on | a subject independency and present on this subject | | | | |
| Workload in Hours | Independent Study Time 96, Study Time | in Lecture 84 | | | | |
| Credit points | 6 | | | | | |
| Course achievement | None | | | | | |
| Examination | Written exam | | | | | |
| | 60 min (chemistry) + presentation | | | | | |
| scale | | | | | | |
| Assignment for the | Civil Engineering: Specialisation Structur | | | | | |
| Following Curricula | | | | | | |
| | Civil Engineering: Specialisation Water and Traffic: Compulsory | | | | | |
| | Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory | | | | | |
| | Chemical and Bioprocess Engineering: Technical Complementary Course: Elective Compulsory | | | | | |
| | International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory | | | | | |
| | Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory | | | | | |
| | Process Engineering: Specialisation Process Engineering: Elective Compulsory | | | | | |
| | Water and Environmental Engineering: S | Specialisation Water: Compulsory | | | | |
| | Water and Environmental Engineering: S | Specialisation Environment: Elective Compulsory | | | | |
| | | | | | | |

| Course L0311: Chemistry of | Drinking Water Treatment |
|----------------------------|---|
| | Lecture |
| Hrs/wk | 2 |
| CP | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Dr. Klaus Johannsen |
| Language | DE |
| Cycle | WiSe |
| Content | The topic of this course is water chemistry with respect to drinking water treatment and water distribution |
| | Major topics are solubility of gases, carbonic acid system and calcium carbonate, blending, softening, redox processes, materials and legal requirements on drinking water treatment. Focus is put on generally accepted rules of technology (DVGW- and DIN- standards). Special emphasis is put on calculations using realistic analysis data (e.g. calculation of pH or calcium carbonate dissolution potential) in exercises. Students can get a feedback and gain extra points for exam by solving problems for homework. Knowledge of drinking water treatment processes is vital for this lecture. Therefore the most important processes are explained coordinated with the course " Water resources management" in the beginning of the semester. |
| Literature | MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John Wiley & Sons, Hoboken, 2005. Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley & Sons, New York, 1996. DVGW (Hrsg.): Wasseraufbereitung - Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004. Jensen, J. N.: A Problem Solving Approach to Aquatic Chemistry. John Wiley & Sons, Inc., New York, 2003. |

| Course L0312: Chemistry of Drinking Water Treatment | | |
|---|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Dr. Klaus Johannsen | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L0402: Water Resour | rce Management |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Mathias Ernst |
| Language | DE |
| Cycle | WiSe |
| Content | The lecture provides comprehensive knowledge on interaction of water ressource management and drinking water supply. Content |
| | overview: Current situation of global water resources User and Stakeholder conflicts Wasserressourcenmanagement in urbane Gebieten Rechtliche Aspekte, Organisationsformen Trinkwasserversorgungsunternehmen. Ökobilanzierung, Benchmarking in der Wasserversorgung |
| Literature | Aktuelle UN World Water Development Reports Branchenbild der deutschen Wasserwirtschaft, VKU (2011) Aktuelle Artikel wissenschaftlicher Zeitschriften Ppt der Vorlesung |

| Course L0403: Water Resour | urse L0403: Water Resource Management | | |
|----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Mathias Ernst | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | |
|------------------------------------|--|-----------------------------|---------------|-------------------|
| Title | Тур | | Hrs/wk | СР |
| Integrated Transportation Planning | | -/problem-based Learning | 4 | 6 |
| Module Responsible | Prof. Carsten Gertz | | | |
| Admission Requirements | None | | | |
| Recommended Previous | some knowledge of transport planning, e.g. through taking the undergra | aduate class "Transport Pl | anning and T | raffic Engineerin |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the following learn | ning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to: | | | |
| | describe interdependencies between land-use/location choice and | d transportation/mobility ł | pehaviour | |
| | explain and evaluate the social, ecological and economic effects | | | res. |
| | relate current issues in the area of integrated transport planning | and formulate an opinion | on them. | |
| | | | | |
| | | | | |
| Skills | Students are able to: | | | |
| | quantify important parameters, which influence travel demand or | are influenced by it. | | |
| | comprehensively examine a pre-defined or self-selected topic from | | es perspectiv | e and document t |
| | results in accordance with scientific conventions. | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to: | | | |
| | provide feedback on topical contents and their teaching. | | | |
| | constructively handle feedback on their own work. | | | |
| | produce results in group work and document these. | | | |
| | | | | |
| | | | | |
| Autonomy | Students are able to: | | | |
| | assess potential consequences of their future professional activiti | es | | |
| | independently plan working on a pre-defined project topic, acquir | | ge and use ar | propriate means |
| | its execution. | | | |
| | | | | |
| | | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | written assignment with presentation during the semester | | | |
| scale | | | | |
| - | Civil Engineering: Specialisation Structural Engineering: Elective Compu | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Elective Com | , , | | |
| | Civil Engineering: Specialisation Coastal Engineering: Elective Compulsor | ry | | |
| | Civil Engineering: Specialisation Water and Traffic: Compulsory Logistics, Infrastructure and Mobility: Specialisation Infrastructure and M | Inhility: Elective Compute | orv | |
| | Water and Environmental Engineering: Specialisation Cities: Compulsory | | . , | |

| Course L1068: Integrated Tr | ansportation Planning |
|-----------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| СР | 6 |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Lecturer | Prof. Carsten Gertz, Dr. Philine Gaffron, Jacqueline Bianca Maaß |
| Language | DE |
| Cycle | WiSe |
| | The course will provide students with an understanding of interdependencies between land-use and transportation. Specific topics include a.o.: interactions between transport and the environment and consequent limitations characteristics of integrated planning complex planning processes interdependencies of location choice and mobility behaviour transport and land-use policies project on current issues in transportation studies |
| Literature | Kutter, Eckhard (2019) Stadtstruktur und Erreichbarkeit in der postfossilen Zukunft. Erich Schmidt Verlag. Berlin. Gies, Huber u. a. (Hrsg.) (93. Ergänzung 2022) Handbuch der kommunalen Verkehrsplanung. Herbert Wichmann Verlag. Berlin, Offenbach. (Loseblattsammlung mit kontinuierlichen Ergänzungen) |

| Module M0963: Steel | and Composite Structures | | | |
|--|--|---|---------|----|
| . | | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Steel and Composite Structures (LI | | Lecture | 2 | 2 |
| Steel and Composite Structures (L1 | 205) | Recitation Section (large) Lecture | 2 | 2 |
| Steel Bridges (L1097) Module Responsible | Drof Marcus Dutner | Lecture | Z | Z |
| Admission Requirements | None | | | |
| Recommended Previous | Basics of steel construction (i.e. Steel Structures I an | | | |
| Knowledge | basics of steel construction (i.e. steel structures far | | | |
| 2 | | | | |
| Educational Objectives | After taking part successfully, students have reached | a the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After successful completition, students can | | | |
| | describe the phenomenon of local buckling | | | |
| | explain warping torsion | | | |
| | illustrate the behaviour of composite structure | es | | |
| | specify the principles in design of composite s | sttructures | | |
| | sketch the contructions of steel and composite | | | |
| | | - | | |
| Skills | After successful participation students are able to | | | |
| | check stiffened and unstiffened plated structure | ires | | |
| | recognize and verify warping tosion in strucur | es | | |
| | design composite structures | | | |
| | design bridges and o perform the detailing | | | |
| Developed Competence | | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy Workload in Hours | Independent Study Time 96, Study Time in Lecture 8 | 24 | | |
| Credit points | 6 | 1 4 | | |
| Course achievement | | | | |
| Examination | Written exam | | | |
| Examination duration and | 180 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineeri | ng: Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engine | • • • | | |
| | Civil Engineering: Specialisation Coastal Engineering | | | |
| | Civil Engineering: Specialisation Water and Traffic: E | | | |
| | Civil Engineering: Specialisation Computational Engin | | | |
| | International Management and Engineering: Speciali | | ulsory | |
| | international Management and Engineering. Special | Satish II. Civil Engineering. Elective Collip | alsol y | |

| Course L1204: Steel and Con | nposite Structures |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Marcus Rutner |
| Language | DE |
| Cycle | WiSe |
| Content | Local-buckling of plated structures Warping torsion Composite-girders, -columns, -slabs, -bridges Principles in composite constructions Bridge-design and -construction |
| Literature | Petersen, C.: Stahlbau, 4.Auflage 2013, Springer-Vieweg Verlag Minnert, J. Wagenknecht, G.: Verbundbau-Praxis - Berechnung und Konstruktion nach Eurocode 4, 2.Auflage 2013, Bauwerk Beuth Verlag |

| ourse L1205: Steel and Composite Structures | | |
|---|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Marcus Rutner | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L1097: Steel Bridges | | | | |
|-----------------------------|--|--|--|--|
| Тур | Lecture | | | |
| Hrs/wk | 2 | | | |
| СР | 2 | | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | | |
| Lecturer | Yves Freundt | | | |
| Language | | | | |
| Cycle | | | | |
| Content | Lecture Contents ,Steel Bridge Construction' DrIng. Jörg Ahlgrimm | | | |
| | bi-ng. Jorg Angrinin | | | |
| | - From tendering and contracting to completion - the development of a steel bridge | | | |
| | - Contents of a bridge static - structural details, examples of analysis in detail: | | | |
| | -> effective width in regard to the longitudinal stiffeners | | | |
| | -> Bearing point, bearing stiffener | | | |
| | -> Crossbeam breakthrough, crossbeam reinforcement | | | |
| | -> Analysis of the Rib-to-Floorbeam (RF) connection (web-tooth of the floorbeam between trapezoidal shaped Ribs) | | | |
| | - Steel grades, -designation, testing methods and approval certificates | | | |
| | Nondestructive weld inspecting | | | |
| | - Corrosion protection | | | |
| | - Bridge bearing - types, format, function, dimensioning, installation | | | |
| | - Expansion Joints | | | |
| | - Oscillation of bridge hangers and cables - oscillation damper | | | |
| | - Opening bridges- Detailed reviews to different assembling procedures and - implements | | | |
| | - Selective damage events | | | |
| | Requirements: Basic knowledge in the calculation, dimensioning, and construction of structural elements and joints of constructional steelwork | | | |
| Literature | | | | |
| | Herbert Schmidt, Ulrich Schulte, Rainer Zwätz, Lothar Bär: Ausführung von Stahlbauten | | | |
| | Petersen, Christian: Stahlbau, Abschnitt Brückenbau | | | |
| | Ahlgrimm, J., Lohrer, I.: Erneuerung der Eisenbahnüberführung in Fulda-Horas über die Fulda, Stahlbau 74 (2005), Heft 2, S. 114 | | | |

| Courses | | | |
|---|--|--|--|
| Title | Typ Hrs/wk CP | | |
| Module Responsible | Dozenten des SD B | | |
| Admission Requirements | None | | |
| Recommended Previous | Subjects of the Foundation Engineering specialisation. | | |
| Knowledge | | | |
| Educational Objectives | After taking part successfully, students have reached the following learning results | | |
| Professional Competence | | | |
| Knowledge | • The students are able to demonstrate their detailed knowledge in the field of geotechnical and foundation engineering. They can exemplify the state of technology and application and discuss critically in the context of actual problems and general conditions of science and society. | | |
| The students can develop solving strategies and approaches for fundamental and practical problems i foundation engineering. They may apply theory based procedures and integrate safety-related, ecological, et view points of science and society. | | | |
| Skills | Scientific work techniques that are used can be described and critically reviewed. The students are able to independently select methods for the project work and to justify this choice. They can explain how the methods relate to the field of work and how the context of application has to be adjusted. General findings and furth developments may essentially be outlined. | | |
| Personal Competence | | | |
| Social Competence | The students are able to condense the relevance and the structure of the project work, the work steps and the sub-problems f the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to the colleagues. | | |
| Autonomy | The students are capable of independently planning and documenting the work steps and procedures while considering the give deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedback from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology. | | |
| Workload in Hours | Independent Study Time 180, Study Time in Lecture 0 | | |
| Credit points | 6 | | |
| Course achievement | None | | |
| Examination | Study work | | |
| Examination duration and scale | see FSPO | | |
| Assignment for the | Civil Engineering: Specialisation Geotechnical Engineering: Compulsory | | |
| Following Curricula | | | |

Module M0969: Selected Topics in Civil Engineering

| Courses | | | | |
|---|---|--|-------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Design of Composite Bridges (L3092) | | Integrated Lecture | 2 | 3 |
| Analysis of Offshore Structures (L1867) | | Lecture | 1 | 1 |
| Energy Geotechnics (L3227) | | Lecture | 3 | 3 |
| Solid Matter Process Technology fo | r Biomass (L0052) | Lecture | 2 | 3 |
| Forum I - Geotechnics and Construe | ction Management (L1634) | Seminar | 1 | 1 |
| Forum II - Geotechnics and Constru | ction Management (L1635) | Seminar | 1 | 1 |
| Timber Structures (L1151) | | Seminar | 2 | 2 |
| Innovative Timber Construction (L2 | 666) | Lecture | 2 | 4 |
| Glass Structures (L1152) | | Lecture | 2 | 2 |
| Glass Structures (L1447) | | Recitation Section (large) | 1 | 1 |
| Sustainable landfill design and oper | ration (L3270) | Integrated Lecture | 3 | 3 |
| Special Topics in Steel Design (L30 | 91) | Integrated Lecture | 2 | 3 |
| Special topics of civil engineering 1 | CP (L2378) | | 1 | 1 |
| Special topics of civil engineering 2 | 2 LP (L2379) | | 2 | 2 |
| Special topics of civil engineering 3 | 3 LP (L2380) | | 3 | 3 |
| Structural Design (L2789) | | Seminar | 2 | 2 |
| Module Responsible | Prof. Frank Schmidt-Döhl | | | |
| Admission Requirements | None | | | |
| Recommended Previous | none | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the following learning results | | | |
| Professional Competence | | | | |
| Knowledge | | | | |
| | Students are able to find their way through selected special areas within civil and structural engineering. | | | |
| | • Students are able to explain basic models and procedures in selected special areas of civil and structural engineering. | | | |
| | Students are able to interrelate scientific and | technical knowledge. | | |
| Skills | Students are able to apply basic methods in selected areas of civil and structural engineering. | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| | | | | |
| Autonomy | Students can chose independently, in which courses. | fields they want to deepen their knowled | dge and skills th | rough the election |
| Workload in Hours | Depends on choice of courses | | | |
| Credit points | 6 | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Elective Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engine | eering: Elective Compulsory | | |
| - | Civil Engineering: Specialisation Coastal Engineering | : Elective Compulsory | | |
| | Civil Engineering: Specialisation Water and Traffic: E | | | |
| | Civil Engineering: Specialisation Computational Engin | | | |
| | ervir Engineering. Specialisation computational Engli | neering. Elective compulsory | | |

| Course L3092: Design of Composite Bridges | |
|---|---|
| Тур | Integrated Lecture |
| Hrs/wk | 2 |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Examination Form | Klausur |
| Examination duration and | 90 min |
| scale | |
| Lecturer | Prof. Marcus Rutner |
| Language | DE |
| Cycle | SoSe |
| Content | |
| Literature | |

Module Manual M.Sc. "Civil Engineering"

| Course L1867: Analysis of Of | |
|------------------------------|---|
| Тур | Lecture |
| | |
| CP Workload in Hours | 1 Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | |
| Examination duration and | |
| scale | |
| Lecturer | Dr. Said Fawad Mohammadi |
| Language | DE/EN |
| Cycle | SoSe |
| Content | Topic 1: Types of Offshore Structures, Fixed and floating structures for Oil & Gas and Offshore Wind industry |
| | Topic 2: Wave Forces, Morisons equation |
| | Topic 3: Irregular Seastates, Power spectrum and application of FFT |
| | Topic 4: Additional Environmental Forces, wind spectra, current forces |
| | Topic 5: Linear-Time-Invariant Systems, response of an LTI-system in frequency domain |
| | Topic 6: Tubular Welded Connections, stress concentration factors, weld geometry |
| | Topic 7: Introduction to Fracture Mechanics, criteria for fracture initiation and crack growth |
| | Topic 8: Time and Frequency Domain Fatigue Analyses, rainflow counting, application of LTI-systems for frequency domain fatigue |
| | Topic 9: Offshore Installation and Exam, installation of structures, pile driving, pipe laying techniques |
| Literature | Chakrabarti, Handbook of Offshore Engineering, 2005 |
| | Sarpkaya, Wave Forces on Offshore Structures, 2010 |
| | Faltinsen, Sea Loads on Ships and Offshore Structures, 1998 |
| | Sorensen, Basic Coastal Engineering, 2006 |
| | Dowling, Mechanical Behavior of Materials, 2007 |
| | Haibach, Betriebsfestigkeit, 2006 |
| | Marshall, Design of Welded Tubular Connections, 1992 |
| | Newland, Random vibrations, spectral and wavelet analysis, 1993 |
| | |

| Course L3227: Energy Geotechnics | |
|----------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Examination Form | Schriftliche Ausarbeitung (laut FPrO) |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt |
| scale | |
| Lecturer | Pauline Kaminski |
| Language | DE/EN |
| Cycle | WiSe |
| Content | Energy geotechnics is a young field in geotechnical engineering with the aim of developing sustainable geotechnical solutions for future-oriented issues relating to the production, transport, operation, decommissioning, and waste utilisation of various energy sources. Examples of possible fields of activity in energy geotechnics include geothermal energy and thermally activated foundation components, foundations for onshore and offshore wind turbines, the decommissioning of mining facilities and the handling of waste products from fossil fuels such as tailings and the geological storage of CO2. Relevant soil mechanical processes in these applications include the thermo-hydro-mechanically coupled behaviour of soils, multiphase flow in porous media and partially saturated soils. The lecture gives an overview of various aspects of energy geotechnics and provides in-depth knowledge of the associated soil mechanical processes. In addition, CO2-scarce geotechnical applications are discussed and emission estimates as well as the optimisation of geotechnical structures according to sustainability aspects are addressed. |
| Literature | |

| Course L0052: Solid Matter F | Process Technology for Biomass |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Examination Form | Klausur |
| Examination duration and | 60 min |
| scale | |
| Lecturer | Prof. Werner Sitzmann |
| Language | DE |
| Cycle | SoSe |
| Content | The industrial application of unit operations as part of process engineering is explained by actual examples of solid biomass |
| | processes. Size reduction, transportation and dosing, drying and agglomeration of renewable resources are described as important |
| | unit operations when producing solid fuels and bioethanol, producing and refining edible oils, when making Btl - and WPC - |
| | products. Aspects of explosion protection and plant design complete the lecture. |
| Literature | Kaltschmitt M., Hartmann H. (Hrsg.): Energie aus Bioamsse, Springer Verlag, 2001, ISBN 3-540-64853-4 |
| | Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz, Schriftenreihe Nachwachsende Rohstoffe, |
| | Fachagentur Nachwachsende Rohstoffe e.V. www.nachwachsende-rohstoffe.de |
| | Bockisch M.: Nahrungsfette und -öle, Ulmer Verlag, 1993, ISBN 380000158175 |
| | |

| Course L1634: Forum I - Geotechnics and Construction Management | |
|---|---|
| Тур | Seminar |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | Mündliche Prüfung |
| Examination duration and | 30 min |
| scale | |
| Lecturer | Prof. Jürgen Grabe |
| Language | DE |
| Cycle | WiSe |
| Content | Lectures about projects and issues with practical and scientific relevance. |
| Literature | |

| Course L1635: Forum II - Geotechnics and Construction Management | |
|--|---|
| Тур | Seminar |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | Mündliche Prüfung |
| Examination duration and | 30 min |
| scale | |
| Lecturer | Prof. Jürgen Grabe |
| Language | DE |
| Cycle | SoSe |
| Content | Lectures about projects and issues with practical and scientific relevance. |
| Literature | |

| Course L1151: Timber Structures | |
|---------------------------------|---|
| Тур | Seminar |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Examination Form | Referat |
| Examination duration and | 90 min |
| scale | |
| Lecturer | Prof. Torsten Faber |
| Language | DE |
| Cycle | WiSe |
| Content | |
| Literature | |

| Course L2666: Innovative Timber Construction | |
|--|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Examination Form | Schriftliche Ausarbeitung |
| Examination duration and | 45 Minuten |
| scale | |
| Lecturer | Dr. Andreas Meisel |
| Language | DE |
| Cycle | WiSe |
| Content | |
| Literature | - Blass, J.: "Ingenieurholzbau" |
| | - Schickhofer, G.: "BSPhandbuch: Holz-Massivbauweise in Brettsperrholz" |
| | - Informationsdienst Holz: div. Merkblätter und Broschüren |
| | - Wallner-Novak M.: Brettsperrholz Bemessung, Band 1 und 2 |
| | - Gerner M.: "Fachwerk: Entwicklung, Instandsetzung, Neubau" |
| | - Meisel, A.: "Historische Dachwerke: Beurteilung, realitätsnahe statische Analyse und Instandsetzung" |
| | - Kempe K.: "Dokumentation Holzschädlinge" |
| | - Huckfeldt T.: "Hausfäule- und Bauholzpilze" |

| Course L1152: Glass Structures | |
|--------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Examination Form | Mündliche Prüfung |
| Examination duration and | |
| scale | |
| Lecturer | Marvin Matzik |
| Language | |
| Cycle | WiSe |
| Content | Glass structures |
| | - Introduction of the material glass (production, refinement, material characteristic) |
| | - design of facades |
| | - facade types |
| | - static calculation of glazing |
| | - static calculation of facades |
| | - load bearing behavior of glazing (plate or membrane stiffness) |
| | - vertical / horizontal glazing with safety-related requirements |
| | - glass structures |
| | - fire safety of glass facades |
| | - construction physics of facades and glazing |
| Literature | |

| Course L1447: Glass Structures | |
|--------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | Mündliche Prüfung |
| Examination duration and | |
| scale | |
| Lecturer | Marvin Matzik |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L3270: Sustainable la | andfill design and operation |
|------------------------------|--|
| Тур | Integrated Lecture |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Examination Form | Klausur |
| Examination duration and | 60 min |
| scale | |
| Lecturer | Dr. Marco Ritzkowski |
| Language | EN |
| Cycle | SoSe |
| Content | The course introduces the development of modern waste resource management and demonstrates the importance of landfills in the context of recycling processes. Based on international (EU) and national legislation, the current landfill situation is presented and the future significance of landfills will be discussed. A central element of the course deals with the main transformation processes in the landfilled waste, the emission of gases and leachate, the long-term behaviour of landfills as well as aftercare and after-utilisation measures. Further focal points of the course are measures for the sustainable reduction of environmentally and climate-damaging emissions and aspects of landfill technology in an international context. |
| Literature | Waste Management. Bernd Bilitewski; Georg Härdtle; Klaus Marek (Eds.), ISBN: 9783540592105, Springer Verlag Lehrbuchsammlung der TUB, Signatur USH-305 Solid Waste Technology and Management. Thomas Christensen (Ed.), ISBN: 978-1-4051-7517-3, Wiley Verlag Lesesaal 2: US - Umweltschutz, Signatur USH-332 Solid Waste Landfilling - Concepts, Processes, Technologies. Cossu, R. and Stegmann, R. (Eds.), ISBN: 978-0-12-818336-6 PDF (Volltext) über TUB |

| Course L3091: Special Topics in Steel Design | |
|--|---|
| Тур | Integrated Lecture |
| Hrs/wk | 2 |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Examination Form | Klausur |
| Examination duration and | 90 min |
| scale | |
| Lecturer | Prof. Marcus Rutner, Nikolay Lalkovski |
| Language | DE |
| Cycle | SoSe |
| Content | |
| Literature | |

| Course L2378: Special topics | ourse L2378: Special topics of civil engineering 1CP | |
|------------------------------|---|--|
| Тур | | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Examination Form | Fachtheoretisch-fachpraktische Arbeit | |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt | |
| scale | | |
| Lecturer | Dozenten des SD B | |
| Language | DE | |
| Cycle | WiSe/SoSe | |
| Content | The course occurs only if required. The content is defined at short notice. | |
| Literature | Die Literatur wird kurzfristig festgelegt. | |

| Course L2379: Special topics | of civil engineering 2 LP |
|------------------------------|---|
| Тур | |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Examination Form | Fachtheoretisch-fachpraktische Arbeit |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt |
| scale | |
| Lecturer | Dozenten des SD B |
| Language | DE |
| Cycle | WiSe/SoSe |
| Content | The course occurs only if required. The content is defined at short notice. |
| Literature | Die Literatur wird kurzfristig festgelegt. |

| Course L2380: Special topics | Course L2380: Special topics of civil engineering 3 LP | |
|------------------------------|---|--|
| Тур | | |
| Hrs/wk | 3 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | |
| Examination Form | Fachtheoretisch-fachpraktische Arbeit | |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt | |
| scale | | |
| Lecturer | Dozenten des SD B | |
| Language | DE | |
| Cycle | WiSe/SoSe | |
| Content | The course occurs only if required. The content is defined at short notice. | |
| Literature | Die Literatur wird kurzfristig festgelegt. | |

| Course L2789: Structural Design | | |
|---------------------------------|---|--|
| Тур | Seminar | |
| Hrs/wk | 2 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Examination Form | Mündliche Prüfung | |
| Examination duration and | 20 min | |
| scale | | |
| Lecturer | Dr. Jan Mittelstädt | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | | |
| Literature | [1] Structure Systems by Heino Engel, Hantje Cantz, 3rd edition (Feb 2007), ISBN-10: 3775718761 | |
| | Form and Force, Designing Efficient, Expressive Structures by Allan, E., Zalewski, W. et al, John Wiley and | |
| | Sons; 1st edition (Sept 2009), ISBN-10: 047017465X | |
| | [2] Peter Rice: An Engineer Imagines, ISBN-10 : 1849944237 | |
| | [3] Konrad Wachsmann and the Grapevine Structure by C. Sumi et al., Park Books (Oct 2018), ISBN-10: | |
| | 9783038601104 | |
| | [4] Manual of Multi-Story Timber Construction by Hermann Kaufmann, Stefan Krotsch, Stefan Winter, DETAIL, | |
| | (June 2018), ISBN-10: 3955533948 | |
| | [5] The Art of Structural Design: A Swiss Legacy by B. Billington, Princeton University Art Museum; First Edition | |
| | edition (Mar 2003), ISBN-10: 0300097867 | |
| | [6] Structured Lineages: Learning from Japanese Structural Design by G. Nordenson et al, The Museum of | |
| | Modern Art (Jul 2019), ISBN-10: 1633450562 | |
| | [7] The Structure: Works of Mahendra Raj by V. Mehta, R. Mehndiretta, A. Huber, Park Books (Oct 2015), | |
| | ISBN-10: 3038600253 | |
| | | |
| | | |

| Courses | |
|---|--|
| Title Adaptation to climate change in hy | Typ Hrs/wk CP rdraulic engineering (L2291) Project-/problem-based Learning 4 6 |
| Module Responsible | Prof. Peter Fröhle |
| Admission Requirements | |
| Recommended Previous Knowledge | Hydrology Hydraulic Engineering |
| Educational Objectives | After taking part successfully, students have reached the following learning results |
| Professional Competence Knowledge Skills | Climate protection and climate adaptation Insights into climate change and its regional characteristics - fundamentals, climate modelling / climate models Impacts of climate change on the components of the regional hydrological cycle Fundamentals of analysis of climate data Consequences of the impact of the climate change Measures for climate adaptation Assessment, prioritization and communication of adaptation measures Fundamentals of the analysis of hydrometeorological and hydrological data |
| Personal Competence Social Competence Autonomy | Working in heterogenous groups Working with different scientific / non-scientific disciplines Self reflection |
| | Autonomous work on complex tasks |
| _ | |
| | Independent Study Time 124, Study Time in Lecture 56 |
| Credit points | |
| Course achievement | |
| Examination Examination duration and scale | Written elaboration Preparation of a written report and a presentation of a complex task. |
| • | Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory |
| Following Curricula | Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Water and Environmental Engineering: Specialisation Cities: Elective Compulsory |
| | Water and Environmental Engineering: Specialisation Environment: Elective Compulsory Water and Environmental Engineering: Specialisation Water: Elective Compulsory |

| Course L2291: Adaptation to | o climate change in hydraulic engineering |
|-----------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| СР | 6 |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Lecturer | Prof. Peter Fröhle |
| Language | DE |
| Cycle | WiSe |
| Content | Climate protection and climate adaptation Findings on climate change and its regional characteristics: fundamentals of climate change, climate modelling / climate models Impacts of climate change on the components of the regional hydrological cycle(climate science view) Fundamentals of the analysis of climate data Concequences of the impacts of climate change (ingenieering science view) Measures for climate change adaptation Assessment, prioritization and communication of measures Fundamentals of analysis of hydrometeorological and hydrological data |
| Literature | Wird bereitgestellt über die HOOU - eLearning Plattform abhängig von den jeweils schwerpunktmäßig behandelten Fragestellungen wird das Schrifttum (aktuelle Paper) in der Veranstaltung bzw. über StudIP zur Verfügung gestellt. |

| Courses | | | | |
|---|---|--|--------|----|
| Title | | Тур | Hrs/wk | СР |
| Scientific Working in Computationa | Engineering (L2764) | Project-/problem-based Learning | 4 | 6 |
| Module Responsible | Prof. Kay Smarsly | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge in scientific writing. String interest in topic | s related to computing in civil engine | ering. | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the for | bllowing learning results | | |
| Professional Competence | | | | |
| <i>Skills</i> Personal Competence <i>Social Competence</i> | course instructors and in collaboration with each other, the students will also learn to understand the complex process of scientific thinking, being able to accurately plan, implement and analyze scientific projects, such as prospective master theses. A project will be conducted throughout the semester, which will contribute to the grade. Since scientific writing is of particular importance in this course, a scientific paper will be developed based, which is a prerequisite for the final examination. The paper will be writter based on the project conducted within this course. Project meetings in small groups, presentations, and critical discussions of scientific publications are further key activities. The students will be capable (i) of solving a scientific problem following a scientific methodology, (ii) of documenting their work effectively in the form of a paper, and (iii) of sharing their work in a presentation. | | | |
| | The students will be able to extend their knowledge and ap | · | | - |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | 10 pages of work with 15-minute oral presentation | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Water and Traffic: Elective | Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: | Elective Compulsory | | |
| | Civil Engineering: Specialisation Coastal Engineering: Election | ve Compulsory | | |
| | Civil Engineering: Specialisation Structural Engineering: Ele | ctive Compulsory | | |
| | Civil Engineering: Specialisation Computational Engineering | g: Elective Compulsory | | |
| | Computer Science: Specialisation II: Intelligence Engineerin | g: Elective Compulsory | | |

| ourse L2764: Scientific Working in Computational Engineering | | |
|--|--|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 4 | |
| СР | 6 | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | |
| Lecturer | Prof. Kay Smarsly | |
| Language | EN | |
| Cycle | WiSe/SoSe | |
| Content | In the course, a scientific problem of practical relevance will first be defined, taking into account the interests of the students participating in the course. The scientific problem will then systematically be solved within the framework of a comprehensive project. The principles of scientific working will be taught based on the scientific problem defined previously. As an integral part of scientific working, fundamentals of scientific writing will be presented and applied to a scientific paper to be written during the course. Topics related to scientific writing include structuring in scientific writing (structuring the abstract, the introduction, the main part, the summary and conclusions, and the acknowledgments and references) and recommendations on effective scientific writing (principles of composition, use of English in scientific writing, useful tips, creating figures, writing in mathematics, referencing, and formal email correspondence). A final paper and a final presentation will be assembled by the students. | |
| Literature | Smarsly, K. & Dragos, K., 2019. Scientific Writing in Engineering. Tredition, Hamburg, Germany. | |

| Courses | | | | |
|---|---|--|----------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Sustainable Nature-based Coastal I | Protection in a Changing Climate (SeaPiaC) (L2926) | Project-/problem-based Learning | 4 | 6 |
| Module Responsible | Prof. Peter Fröhle | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Hydraulic Engineering Hydromechanics, Hydraulics Fundamentals of Coastal Engineering, Coastal- an | d Flood Protection | | |
| Educational Objectives | After taking part successfully, students have reached the | e following learning results | | |
| Professional Competence Knowledge | Climate and Climate Change General Impacts of Climate Change on Wind Regi Consequences of Climate Change for Coastal Procedure Coastal Protection in Taiwan and Germany Fundamentals of Climate Adaptation Nature-based Solutions (NBS) for Coastal Protection | lesses | | |
| Skills | Critical thinking: analysis of processes and relatio Creative thinking: development of adaptation stra Practical thinking: inclusion of restrictions, appl methods Consideration of complex tasks | tegies and adaptation measures | nods, numerica | ıl models, plannir |
| Personal Competence | | | | |
| Social Competence | Working in heterogenous groups Working in international groups Working with different scientific / non-scientific dis Self reflection | sciplines | | |
| Autonomy | Application oriented use of knowledge and skills Autonomous work on complex tasks | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | Preparation of a written report on a complex task with | a presentation and subsequent discussion | on. The work o | n the complex ta |
| scale | happens in the course of the lecture. | | | |
| Assignment for the Following Curricula | Civil Engineering: Specialisation Coastal Engineering: Ele Civil Engineering: Specialisation Geotechnical Engineering: Civil Engineering: Specialisation Structural Engineering: Civil Engineering: Specialisation Water and Traffic: Electi Environmental Engineering: Specialisation Environment | ng: Elective Compulsory Elective Compulsory ive Compulsory and Climate: Elective Compulsory | | |
| | Water and Environmental Engineering: Specialisation Cit Water and Environmental Engineering: Specialisation En Water and Environmental Engineering: Specialisation Wa | vironment: Elective Compulsory | | |

| Course L2926: Sustainable N | lature-based Coastal Protection in a Changing Climate (SeaPiaC) |
|-----------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| СР | 6 |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Lecturer | Prof. Peter Fröhle |
| Language | EN |
| Cycle | WiSe |
| Content | Climate and Climate Change General Impacts of Climate Change on Wind Regime and Water Cycle Consequences of Climate Change for Coastal Processes Coastal Protection in Taiwan and Germany Fundamentals of Climate Adaptation Nature-Based Solutions (NBS) for Coastal Protection |
| Literature | Materials provided on eLearning Platform (HOOU Platform) Depending on the main topics of the course in the respective year, the literature (recent papers) will be provided in the course-material or via StudIP. |

| Module M1844: Mode | rn discretization methods in stru | ictural mechanics | | |
|--|--|--|--------------------|--------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Modern discretization methods in s | tructural mechanics (L3043) | Lecture | 2 | 3 |
| Modern discretization methods in structural mechanics (L3044) Recitation Section (small) 2 3 | | | 3 | |
| Module Responsible | Prof. Bastian Oesterle | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Finite Element MethodsFlächentragwerke | | | |
| Educational Objectives | After taking part successfully, students have rea | ached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After successful completion of this module, stur mechanics. | dents can express the basic aspects of moder | n discretization r | nethods in structu |
| Skills | After successful completion of this module, the students will be able to use and further improve modern discretization methods for problems in structural mechanics. | | | |
| Personal Competence | | | | |
| Social Competence | Students can | | | |
| | participate in subject-specific and interdi | scinlinary discussions | | |
| | defend their own work results in front of | | | |
| | promote the scientific development of co | | | |
| | • Furthermore, they can give and accept p | rofessional constructive criticism | | |
| Autonomy | Students are able to gain knowledge of the sub | iect area from given and other sources and a | only it to new pro | blems Furthermor |
| hatohomy | they are able to structure the solution process f | | | bienis. Furthermol |
| Workload in Hours | Independent Study Time 124, Study Time in Leo | ture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Engine | ering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical E | ngineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Structural Engi | neering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Computational | | | |
| | Theoretical Mechanical Engineering: Specialisat | ion Simulation Technology: Elective Compulso | ry | |

| Course L3043: Modern discre | etization methods in structural mechanics |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Bastian Oesterle |
| Language | EN |
| Cycle | WiSe |
| Content | The course covers variational formulations, various locking phenomena and alternative formulations for finite elements and modern discretization schemes in the context of structural mechanics, like isogeometric analysis. variational formulation of finite elements, mixed variational principles geometrical and material locking effects in structural and solid mechanics hybrid-mixed and enhanced assumed strain finite element formulations, reduced integration and stabilization, DSG method, u-p formulations patch test, stability, convergence linear and non-linear analyses introduction to isogeometric analysis isogeometric beam, plate and shell formulations locking effects and their avoidance in modern, smooth discretization schemes, like isogeometric analysis |
| Literature | lecture notes and selected scientific papers O.C. Zienkiewicz, R.L. Taylor, and J.Z. Zhu: Finite Element Method: Its Basis and Fundamentals. Elsevier, 2013. J. Austin Cottrell, Thomas J. R Hughes, Yuri Bazilevs: Isogeometric Analysis: Toward Integration of CAD and FEA. Wiley, 2009. |

| Course L3044: Modern discre | urse L3044: Modern discretization methods in structural mechanics | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Bastian Oesterle | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Typ Lecture g learning results vith case studies), | Hrs/wk 2 2 | CP 3 3 |
|---|--|---|
| Lecture Lecture g learning results vith case studies), | 2 | 3 |
| g learning results | | |
| g learning results vith case studies), | 2 | 3 |
| vith case studies), | | |
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| utions. | | |
| and organize their time | e and learning manager | ment based on th |
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| | entitled to? on in a legally balance struction) on the const lutions. | the construction process, entitled to? on in a legally balanced way. Students learn h struction) on the construction site in a target lutions. and organize their time and learning manager mpulsory re Compulsory Compulsory ulsory |

| Course L3182: Construction | urse L3182: Construction law BGB and VOB - law in (excavation) practice | | |
|----------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Günther Schalk | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | | | |
| Literature | Literatur: - Folienskript (in der Vorlesung erhältlich) - Fuchs/Maurer/Schalk: Handbuch Tiefbaurecht | | |

| Course L3181: Construction | urse L3181: Construction disputes from construction (excavation) practice | | |
|----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Ingo Junker | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | | | |
| Literature | | | |

| Courses | | | | | |
|---|--|--------------------------------------|---------------------|-----------------------|--------------------|
| Title | | Тур | | Hrs/wk | СР |
| Coastal- and Flood Protection (L080 | 8) | Lecture | | пі 5/ w к 2 | 3 |
| Coastal- and Flood Protection (L141 | - / | | m-based Learning | 1 | 1 |
| Maintenance and Defence of Flood | Protection Structures (L1411) | Lecture | 5 | 2 | 2 |
| Module Responsible | Prof. Peter Fröhle | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Coastal Engineering I | | | | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students have | e reached the following learning res | ults | | |
| Professional Competence | | | | | |
| Knowledge | The students have the capability to define | and explain in detail the importan | t aspects of erosic | on protection | and flood protecti |
| | and are able to apply the aspects to practical coastal protection problems. They are able to design and dimension importan | | | | |
| | coastal protection measures from the function | onal and from the constructional po | pint of view. | | |
| Skills The students are able to select design approaches for the functional and constructional design of eros | | | in of erosion | and flood protect | |
| Skiis | measures and apply these approaches to practical design tasks. | | | | |
| | | 5 | | | |
| Personal Competence | | | | | |
| Social Competence | The students are able to deploy their gain | • • • • | | | - |
| | coastal and flood protection structures. Add | | | | isciplines. |
| - | The students will be able to independently e | •, | to new problems. | | |
| | Independent Study Time 110, Study Time in Lecture 70 | | | | |
| Credit points | | | | | |
| Course achievement | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and | The duration of the examination is 130 m | in. The examination includes tasks | s with respect to | the general u | inderstanding of t |
| scale | lecture contents and calculations tasks. | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Eng | jineering: Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnic | al Engineering: Elective Compulsor | ý | | |
| | Civil Engineering: Specialisation Structural E | | | | |
| | Environmental Engineering: Specialisation E | nvironment and Climate: Elective C | Compulsory | | |
| | | | | | |
| | Environmental Engineering: Specialisation V Water and Environmental Engineering: Specialisation | | | lsory | |

| Course L0808: Coastal- and F | lood Protection | |
|------------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | of. Peter Fröhle | |
| Language | N | |
| Cycle | WiSe | |
| Content | Protection of sandy coasts | |
| | Sediment transport Morphology Technical solution for the protection of sandy coasts Construction in direction of the coast Constructions perpendicular to the coast Other Concepst Calculation approaches and numerical models Flood Protection Classification of constructions / measures Dikes Dunes Foreland - constructions Flood-Protection Walls Drainage of the hinterland | |
| Literature | Vorlesungsumdruck | |
| 1 | Coastal Engineering Manual CEM | |

| Course L1415: Coastal- and I | urse L1415: Coastal- and Flood Protection | | |
|------------------------------|---|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Peter Fröhle | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Course L1411: Maintenance | and Defence of Flood Protection Structures |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Olaf Müller |
| Language | EN |
| Cycle | WiSe |
| Content | Dike protection Maintennance of flood protection measures |
| Literature | Vorlesungsumdruck |

| Courses | | | | |
|---|---|--|----------------------------------|-----------------|
| Title | | Тур | Hrs/wk | СР |
| Waste and Environmental Chemist | | Practical Course | 2 3 | 2 4 |
| Biological Waste Treatment (L0318 | | Project-/problem-based Learning | 5 | 4 |
| Module Responsible | | | | |
| Admission Requirements | | | | |
| | chemical and biological basics | | | |
| Knowledge | | and the felle of the state of the second second second | | |
| Educational Objectives | | reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | design and layout of anaerobic and aerobic w | ing the planning of biological waste treatment plan vaste treatment plants in detail, describe different to nd explain different methods for waste analytics. | | |
| Skills | The students are able to discuss the compilation of design and layout of plants. They can critically evaluate techniques and qual control measurements. The students can recherché and evaluate literature and date connected to the tasks given in der mode and plan additional tests. They are capable of reflecting and evaluating findings in the group. | | | |
| Personal Competence | | | | |
| • | | and interdisciplinary discussions, develop cooperate | ed solutions ar | nd defend their |
| Social competence | | the scientific development in front of colleagues | | |
| Autonomy | Students can independently tap knowledge from literature, business or test reports and transform it to the course projects. The are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define furth steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with the potential social, economic and cultural impact. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in L | Lecture 70 | | |
| Credit points | | | | |
| Course achievement | | Description | | |
| | Yes None Subject theoretical | and | | |
| | practical work | | | |
| | Drecentation | | | |
| Examination | Presentation | | | |
| | Elaboration and Presentation (15-25 minutes | in groups) | | |
| | Elaboration and Presentation (15-25 minutes | in groups) | | |
| Examination duration and | Elaboration and Presentation (15-25 minutes | | | |
| Examination duration and scale | Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engin | neering: Elective Compulsory | | |
| Examination duration and scale Assignment for the | Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engin | neering: Elective Compulsory I Engineering: Elective Compulsory | | |
| Examination duration and scale Assignment for the | Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engir Civil Engineering: Specialisation Geotechnical | neering: Elective Compulsory I Engineering: Elective Compulsory Igineering: Elective Compulsory | | |
| Examination duration and scale Assignment for the | Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engir Civil Engineering: Specialisation Geotechnical Civil Engineering: Specialisation Structural En Civil Engineering: Specialisation Water and Tr | neering: Elective Compulsory I Engineering: Elective Compulsory Igineering: Elective Compulsory | | |
| Examination duration and scale Assignment for the | Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engir Civil Engineering: Specialisation Geotechnical Civil Engineering: Specialisation Structural En Civil Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation A - Ge | neering: Elective Compulsory I Engineering: Elective Compulsory Igineering: Elective Compulsory raffic: Elective Compulsory | pulsory | |
| Examination duration and scale Assignment for the | Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engir Civil Engineering: Specialisation Geotechnical Civil Engineering: Specialisation Structural En Civil Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation A - Ge Chemical and Bioprocess Engineering: Specia | neering: Elective Compulsory I Engineering: Elective Compulsory Igineering: Elective Compulsory raffic: Elective Compulsory neral Bioprocess Engineering: Elective Compulsory | | |
| Examination duration and scale Assignment for the | Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engir Civil Engineering: Specialisation Geotechnical Civil Engineering: Specialisation Structural En Civil Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation A - Ge Chemical and Bioprocess Engineering: Specia Chemical and Bioprocess Engineering: Specia | neering: Elective Compulsory I Engineering: Elective Compulsory Igineering: Elective Compulsory raffic: Elective Compulsory neral Bioprocess Engineering: Elective Compulsory Ilisation General Process Engineering: Elective Comp | ry | |
| Examination duration and scale Assignment for the | Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engir Civil Engineering: Specialisation Geotechnical Civil Engineering: Specialisation Structural En Civil Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation A - Ge Chemical and Bioprocess Engineering: Specia Chemical and Bioprocess Engineering: Specia Chemical and Bioprocess Engineering: Specia | neering: Elective Compulsory I Engineering: Elective Compulsory Igineering: Elective Compulsory raffic: Elective Compulsory neral Bioprocess Engineering: Elective Compulsory Ilisation General Process Engineering: Elective Compulsor | ry npulsory | ry |
| Examination duration and scale Assignment for the | Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engir Civil Engineering: Specialisation Geotechnical Civil Engineering: Specialisation Structural En Civil Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation A - Ge Chemical and Bioprocess Engineering: Specia Chemical and Bioprocess Engineering: Specia Chemical and Bioprocess Engineering: Specia | neering: Elective Compulsory I Engineering: Elective Compulsory Igineering: Elective Compulsory raffic: Elective Compulsory neral Bioprocess Engineering: Elective Compulsory Ilisation General Process Engineering: Elective Compulsor Ilisation Bioprocess Engineering: Elective Compulsor Ilisation Chemical Process Engineering: Elective Compulsor | ry npulsory | ry |
| Examination duration and scale Assignment for the | Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engir Civil Engineering: Specialisation Geotechnical Civil Engineering: Specialisation Structural En Civil Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation A - Ge Chemical and Bioprocess Engineering: Specia Chemical and Bioprocess Engineering: Specia | neering: Elective Compulsory I Engineering: Elective Compulsory Igineering: Elective Compulsory raffic: Elective Compulsory neral Bioprocess Engineering: Elective Compulsory Ilisation General Process Engineering: Elective Compulsor Ilisation Bioprocess Engineering: Elective Compulsor Ilisation Chemical Process Engineering: Elective Compulsor | ry npulsory :tive Compulso | ry |
| Examination duration and scale Assignment for the | Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engir Civil Engineering: Specialisation Geotechnical Civil Engineering: Specialisation Structural En Civil Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation A - Ge Chemical and Bioprocess Engineering: Specia Chemical and Bioprocess Engineering: Specia Environmental Engineering: Core Qualification International Management and Engineering: Special Process Engineering: Specialisation Environment | neering: Elective Compulsory I Engineering: Elective Compulsory Igineering: Elective Compulsory raffic: Elective Compulsory Ilisation General Process Engineering: Elective Compulsory Ilisation Bioprocess Engineering: Elective Compulsor Ilisation Chemical Process Engineering: Elective Compulsor Ilisation Chemical and Bio process Engineering: Elective Compulsory Ilisation Chemical and Bio process Engineering: Elective Compulsory Ilisation II. Renewable Energy: Elective Compulsory Especialisation II. Renewable Energy: Elective Compulsory | ry npulsory :tive Compulso | ry |
| Examination duration and scale Assignment for the | Elaboration and Presentation (15-25 minutes Civil Engineering: Specialisation Coastal Engir Civil Engineering: Specialisation Geotechnical Civil Engineering: Specialisation Structural En Civil Engineering: Specialisation Water and Tr Bioprocess Engineering: Specialisation A - Ge Chemical and Bioprocess Engineering: Specia Chemical and Bioprocess Engineering: Specia Environmental Engineering: Core Qualification International Management and Engineering: S | neering: Elective Compulsory I Engineering: Elective Compulsory Igineering: Elective Compulsory raffic: Elective Compulsory Ilisation General Process Engineering: Elective Compulsory Ilisation Bioprocess Engineering: Elective Compulsor Ilisation Chemical Process Engineering: Elective Com Ilisation Chemical and Bio process Engineering: Elective Com Ilisation Chemical and Bio process Engineering: Elective Com Ilisation Chemical and Bio process Engineering: Elective Compulsory Specialisation II. Renewable Energy: Elective Compuler Intal Process Engineering: Elective Compulsory alisation Cities: Elective Compulsory | ry npulsory :tive Compulso | ry |

| Course L0328: Waste and En | vironmental Chemistry |
|----------------------------|--|
| | Practical Course |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Kerstin Kuchta |
| Language | EN |
| Cycle | WiSe |
| Content | The participants are divided into groups. Each group prepares a transcript on the experiment performed, which is then used as basis for discussing the results and to evaluate the performance of the group and the individual student. In some experiments the test procedure and the results are presented in seminar form, accompanied by discussion and results evaluation. Experiments ar e.g. Screening and particle size determination Fos/Tac AAS Chalorific value |
| Literature | Scripte |

| Course L0318: Biological Wa | ste Treatment | |
|-----------------------------|---|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | | |
| СР | 4 | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | |
| Lecturer | Prof. Kerstin Kuchta | |
| Language | EN | |
| Cycle | WiSe | |
| Content | Introduction biological basics determination process specific material characterization aerobic degradation (Composting, stabilization) anaerobic degradation (Biogas production, fermentation) Technical layout and process design Flue gas treatment Plant design practical phase | |
| Literature | | |

| Courses | | | | |
|---|--|--|---------------------|----------------------|
| Title | | Тур | Hrs/wk | СР |
| Finite element modeling of structures (L3046) | | Lecture | 2 | 3 |
| Finite element modeling of structur | es (L3047) | Recitation Section (small) | 2 | 3 |
| Module Responsible | Prof. Bastian Oesterle | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Finite Element Methods | | | |
| Knowledge | Thin-walled structures | | | |
| | | | | |
| Educational Objectives | After taking part successfully, students have | e reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After successful completion of this module, | students can express the basic aspects of modelli | ng of structures v | with finite elements |
| Skills | /s After successful completion of this module, the students will be able to model structures with finite elements and to | | | ents and to analy |
| SKIIIS | structures using appropriate computational | | with finite cieffi | |
| | structures using appropriate computational | incentous. | | |
| Personal Competence | | | | |
| Social Competence | Students can | | | |
| | participate in subject-specific and interest | erdisciplinary discussions | | |
| | defend their own work results in front | | | |
| | promote the scientific development o | | | |
| | • Furthermore, they can give and acce | • | | |
| | | | | |
| Autonomy | | subject area from given and other sources and ap | | |
| | they are able to structure the solution proce | ss for problems in the area of finite element mode | elling of structure | es. |
| Workload in Hours | Independent Study Time 124, Study Time in | Lecture 56 | | |
| Credit points | | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | written elaboration of a project work (10-15 | pages) | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Computatio | nal Engineering: Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Coastal Eng | ineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Geotechnic | al Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Structural E | ngineering: Elective Compulsory | | |
| | Theoretical Mechanical Engineering: Special | isation Simulation Technology: Elective Compulso | rv | |

| Course L3046: Finite element | t modeling of structures |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Bastian Oesterle |
| Language | EN |
| Cycle | WiSe |
| | Basic phenomena and aspects of the finite element modelling of structures are discussed. Besides theoretical decription of the phenomena and methods, a strong focus is on the practical use a commercial finite element software within computer-based exercises. The covered topics are: finite element modeling of trusses/beams/frames, plates subject to in-plane/out-of-plane loading and shells convergence properties of displacements and stresses singularities locking effects critical assessment, interpretation and check of results mixed-dimensional coupling of finite elements geometrically linear and non-linear, and material linear and non-linear analyses stability: bifurcation and snap-through problems dynamic problems, modal analyses |
| Literature | Vorlesungsmanuskript, Vorlesungsfolien |

| Course L3047: Finite elemen | Irse L3047: Finite element modeling of structures | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Bastian Oesterle | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | | |
|-----------------------------------|---|--|-------------|---------------------|--|
| Fitle | | T | Une (colo | СР | |
| Modeling of Subsurface Processes | (12721) | Typ Recitation Section (small) | Hrs/wk 3 | 3 | |
| Subsurface Solute Transport (L272 | | Lecture | 2 | 2 | |
| Subsurface Solute Transport (L272 | | Recitation Section (large) | 1 | 1 | |
| Module Responsible | Prof. Nima Shokri | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Basic Mathematics, Hydrology | | | | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students ha | ave reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | Upon completion of this module, the students will understand the mechanisms controlling solute transport in soil and natu porous media and will be able to work with the equations that govern the fate and transport of solutes in porous media. Analytic numerical and experimental tools and techniques will be used in this module. | | | | |
| Skills | In addition to the physical insights, the students will be exposed to analytical, experimental and numerical tools and techniques this module. This provides them with an excellent opportunity to improve their skills on multiple fronts which will be useful in th future career. | | | | |
| Personal Competence | | | | | |
| Social Competence | Teamwork & problem solving | | | | |
| Autonomy | my The students will be involved in writing individual reports and presentation. This will contribute to the student | | | students' ability a | |
| | willingness to work independently and res | sponsibly. | | | |
| Workload in Hours | Independent Study Time 96, Study Time i | n Lecture 84 | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Subject theoretical and practical work | | | | |
| Examination duration and | Report | | | | |
| scale | | | | | |
| Assignment for the | Civil Engineering: Specialisation Structura | l Engineering: Elective Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechr | ical Engineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Coastal E | ngineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Water an | d Traffic: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Computational Engineering: Elective Compulsory | | | | |
| | Chemical and Bioprocess Engineering: Teo | chnical Complementary Course: Elective Compulse | ory | | |
| | Environmental Engineering: Core Qualifica | ation: Compulsory | | | |
| | Process Engineering: Specialisation Enviro | onmental Process Engineering: Elective Compulsor | у | | |
| | Process Engineering: Specialisation Proces | ss Engineering: Elective Compulsory | | | |
| | Water and Environmental Engineering: Sp | ecialisation Water: Compulsory | | | |
| | Water and Environmental Engineering: Sp | | | | |

| Course L2731: Modeling of S | ourse L2731: Modeling of Subsurface Processes | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 3 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | |
| Lecturer | Dr. Milad Aminzadeh | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | Basic usage and background of chosen computer software to calculate flow and transport in the saturated and unsaturated zone and to analyze field data like pumping test data | | |
| Literature | | | |

| Course L2728: Subsurface So | olute Transport |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Nima Shokri |
| Language | EN |
| Cycle | WiSe |
| Content | Basic physical properties of soil: Definition and quantification; Liquid flow in soils (Darcy's law); Solute transport in soils; Practical analysis to measure dispersion coefficient in soil under different boundary conditions; Advanced topics (e.g. Application of Artificial Intelligence to predict soil salinization) |
| Literature | - Environmental Soil Physics, by Daniel Hillel - Soil Physics, Sixth Edition, by William A. Jury and Robert Horton |

| Course L2729: Subsurface So | urse L2729: Subsurface Solute Transport | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Hannes Nevermann | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

Specialization Structural Engineering

| Module M0699: Geote | chnics III | | | |
|----------------------------------|--|--|----------------------|------------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Numerical Methods in Geotechnics | (L0375) | Lecture | 3 | 3 |
| Advanced Foundation Engineering | | Lecture | 2 | 2 |
| Advanced Foundation Engineering | | Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof. Jürgen Grabe | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Geotechnics I and II, Mathematics I-III | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the | following learning results | | |
| Professional Competence | | | | |
| Knowledge | After successfully completing the module, students will be | e able to | | |
| | describe individual procedures for the geotechnica | monitoring of civil engineering me | SUIPS | |
| | reproduce exploration and investigation methods of | | asures, | |
| | select suitable types of field and laboratory tests for | | their results | |
| | state the differences between various stress and d | | | variants of the stress |
| | and distortion tensor, | | orginited ite of ite | |
| | outline the standard and special soil mechanics tes | ts used to determine the stress-stra | in behavior of soi | l. |
| | describe continuum models and the resulting boun | | | |
| | as well as define boundary value problems from th | e field of geotechnical engineering | in such a way tha | t they can be solved |
| | unambiguously. | | | |
| Skills | Students will be able to | | | |
| | dimension vertical drains for soil improvement of s | oft soils, | | |
| | calculate depth compaction using various appropri- | ate methods, | | |
| | apply principles of horizontal bearing capacity of pi | les, | | |
| | verify the internal and external stability of fluid-sup | ported diaphragm walls, | | |
| | evaluate the boundary conditions for the design | n of a deep excavation and desig | n the individual | components of the |
| | excavation, | | | |
| | perform, evaluate and interpret tests for the description | ption and classification of soils acco | rding to applicabl | e standards, |
| | computationally implement numerical algorithms to | o solve boundary value problems, | | |
| | select and apply the types of analyses depending of | on the degree of saturation, the imp | act, and the mate | rial behavior |
| | determine appropriate model parameters for differ | ent possibilities and limitations of n | naterial models fo | r the grain structure |
| | of soils. | | | |
| Personal Competence | | | | |
| Social Competence | Students can work in groups and support each other in fir | ding solutions. | | |
| Autonomy | Students are able to assess their own strengths and weak and think in terms of processes. | nesses and, based on this, organize | their time and le | arning management |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: C | ompulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering | | | |
| | Civil Engineering: Specialisation Coastal Engineering: Con | npulsory | | |
| | Civil Engineering: Specialisation Water and Traffic: Electiv | e Compulsory | | |
| | Civil Engineering: Specialisation Computational Engineering | ng: Compulsory | | |
| | International Management and Engineering: Specialisation | n II. Civil Engineering: Elective Com | oulsory | |
| | | | | |

| Course L0375: Numerical Me | thods in Geotechnics | | | |
|----------------------------|---|--|--|--|
| Тур | Lecture | | | |
| Hrs/wk | | | | |
| СР | 3 | | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | | |
| Lecturer | Dr. Hans Mathäus Stanford | | | |
| Language | DE | | | |
| Cycle | WiSe | | | |
| Content | Topics: | | | |
| | Introduction to numerical soil mechanics Introduction to numerical mathematics Finite Element Method (analysis procedures, algorithms) Finite Element Method (application in geotechnical engineering) | | | |
| Literature | Wriggers P. (2001): Nichtlineare Finite-Elemente-Methoden. Springer Wriggers P. (2008): Nonlinear Finite Element Methods. Springer Deutsche Gesellschaft für Geotechnik e.V. (Hrsg., 2014): Empfehlungen des Arbeitskreises "Numerik in der Geotechnik". Ernst & Sohn | | | |

| Course L0497: Advanced Fou | Indation Engineering | | |
|----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | dependent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | rof. Jürgen Grabe | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Vertical drains Piles Ground improvement (Deep Compaction, Soil mixing) Vibration driving Jet grouting Slurry wall Deep excavation | | |
| Literature | EAK (2002): Empfehlungen für Küstenschutzbauwerke EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke EAB (1988): Empfehlungen des Arbeitskreises Baugruben Grundbau-Taschenbuch, Teil 1-3, (1997), Ernst & Sohn Verlag | | |

| Course L0498: Advanced Fou | ourse L0498: Advanced Foundation Engineering | | |
|----------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Jürgen Grabe | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| | | 25 | | | | |
|--|--|---|---|--|--------------------|--------------------|
| Courses | | | | | | |
| litle . | | | т | Тур | Hrs/wk | СР |
| Concrete Structures (L0579) | | | | Seminar | 1 | 1 |
| Structural Concrete Members (L05 | | | | | 3 | |
| Structural Concrete Members (L05 | | | | | | 2 |
| Module Responsible | NN | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | vious Basics of structural analysis, conception and dimensioning of structural concrete | | | | | |
| Knowledge | | | | | | |
| | Modules: Reinforced | d Concrete Structures I | +II, Structural Analysis I- | +II, Mechanics I+II | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Educational Objectives | After taking part su | iccessfully students ha | ve reached the following | learning results | | |
| Professional Competence | , iter taking part ba | iecessiany, stadents na | ie reached the following | i carring results | | |
| | The students broad | lon their skills in struct | | ally in the field of buildings | (houses roofs ha | alls) They dispose |
| Knowledge | | | | and structural members t | | |
| | the knowledge for t | the conception and des | ight of concrete buildings | | | |
| Skills | The students are al | ble to apply procedure | s of the conception and | dimensioning to to practic | al problems of st | ructural engineeri |
| | They are capable to draft concrete buildings and to design them for general action effects and to plan their detailing execution. Moreover, they can make design and construction sketches and draw up technical descriptions. | | | their detailing a | | |
| | | | | | | |
| Demonal Commetence | | | | | | |
| Personal Competence | | | | | | |
| | The students are able to obtain results of high quality in teamwork. | | | | | |
| Social Competence | The students are ab | Die to obtain results of . | nigh quality in teamwork | | | |
| | | | | sioning tasks of structures | under the guidance | e of tutors. |
| Autonomy | The students are ab | ble to carry out comple: | x conception and dimens | | under the guidand | e of tutors. |
| Autonomy | The students are ab | | x conception and dimens | | under the guidanc | e of tutors. |
| Autonomy | The students are ab Independent Study 6 | ble to carry out comple: Time 110, Study Time | x conception and dimens | | under the guidanc | e of tutors. |
| Autonomy Workload in Hours | The students are ab Independent Study 6 Compulsory Bonus | ble to carry out comple: Time 110, Study Time Form | x conception and dimens in Lecture 70 Description | sioning tasks of structures | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement | The students are ab Independent Study 6 Compulsory Bonus No None | ble to carry out comple: Time 110, Study Time | x conception and dimens in Lecture 70 Description | | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination | The students are ab Independent Study 6 Compulsory Bonus No None Written exam | ble to carry out comple: Time 110, Study Time Form | x conception and dimens in Lecture 70 Description | sioning tasks of structures | under the guidanc | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and | The students are ab Independent Study 6 Compulsory Bonus No None Written exam | ble to carry out comple: Time 110, Study Time Form | x conception and dimens in Lecture 70 Description | sioning tasks of structures | under the guidanc | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination | The students are ab Independent Study 6 Compulsory Bonus No None Written exam | ble to carry out comple: Time 110, Study Time Form | x conception and dimens in Lecture 70 Description | sioning tasks of structures | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale | The students are ab Independent Study 6 Compulsory Bonus No None Written exam 120 minutes | ble to carry out comple: Time 110, Study Time Form Presentation | x conception and dimens in Lecture 70 Description | sioning tasks of structures | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | The students are ab Independent Study 6 Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Sp | ble to carry out comple: Time 110, Study Time Form Presentation Specialisation Structural | x conception and dimens in Lecture 70 Description Es werden 2 Re | sioning tasks of structures | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | The students are ab Independent Study 6 Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Sp Civil Engineering: Sp | ble to carry out comple: Time 110, Study Time Form Presentation Specialisation Structural Specialisation Geotechn | x conception and dimens in Lecture 70 Description Es werden 2 Re Engineering: Compulsor | sioning tasks of structures | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | The students are ab Independent Study 6 Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Sp Civil Engineering: Sp Civil Engineering: Sp | ble to carry out comple: Time 110, Study Time Form Presentation Specialisation Structural Specialisation Geotechn Specialisation Coastal En | x conception and dimens in Lecture 70 Description Es werden 2 Re Engineering: Compulsor ical Engineering: Elective | sioning tasks of structures eferate ausgegeben ry e Compulsory ipulsory | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | The students are ab Independent Study 6 Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Sp Civil Engineering: Sp Civil Engineering: Sp Civil Engineering: Sp Civil Engineering: Sp | ble to carry out complex Time 110, Study Time Form Presentation Specialisation Structural Specialisation Geotechn Specialisation Coastal Er Specialisation Water and | x conception and dimens in Lecture 70 Description Es werden 2 Re Engineering: Compulsor ical Engineering: Elective ngineering: Elective Com | sioning tasks of structures eferate ausgegeben ry e Compulsory ipulsory lsory | under the guidand | e of tutors. |

| Course L0579: Concrete Stru | ictures |
|-----------------------------|---|
| Тур | Seminar |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | NN |
| Language | DE |
| Cycle | WiSe |
| Content | With help of a project teamwork the subjects of the course "Concrete Structures" is practiced, discussed and presented. |
| Literature | - Projektbezogene Unterlagen werden abgegeben. |

| Тур | Lecture |
|-------------------|---|
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | NN |
| Language | DE |
| Cycle | WiSe |
| Content | skyscrapers: structural elements actions on structrues bracing systems design orf slabs (line and point supported plates and floor slabs) membranes and deep beams folded plates and shells truss models reinforced and prestressed members |
| Literature | Vorlesungsunterlagen können im STUDiP heruntergeladen werden Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003 Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalende 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992 Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin, 1973 Schlaich J.; Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst & Sohn, Berlin, 1998 Dames KH.: Rohbauzeichnungen Bewehrungszeichnungen. Bauverlag, Wiesbaden 1997 |

| Course L0578: Structural Concrete Members | | |
|---|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | NN | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Modulo M0063: Stool | and Composite Structures | | | |
|------------------------------------|--|--------------------------------|--------|----|
| Module M0905: Steel | and composite structures | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Steel and Composite Structures (L1 | 204) | Lecture | 2 | 2 |
| Steel and Composite Structures (L1 | 205) | Recitation Section (large) | 2 | 2 |
| Steel Bridges (L1097) | | Lecture | 2 | 2 |
| Module Responsible | Prof. Marcus Rutner | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basics of steel construction (i.e. Steel Structures I and | d II, BUBC) | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached | the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After successful completition, students can | | | |
| | describe the phenomenon of local buckling | | | |
| | explain warping torsion | | | |
| | illustrate the behaviour of composite structure | S | | |
| | specify the principles in design of composite si | | | |
| | sketch the contructions of steel and composite | | | |
| | | | | |
| Skills | After successful participation students are able to | | | |
| | check stiffened and unstiffened plated structure | res | | |
| | recognize and verify warping tosion in strucure | 25 | | |
| | design composite structures | | | |
| | design bridges and o perform the detailing | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 8 | 4 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 180 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering | ng: Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engine | ering: Elective Compulsory | | |
| - | Civil Engineering: Specialisation Coastal Engineering: | | | |
| | Civil Engineering: Specialisation Water and Traffic: El | | | |
| | Civil Engineering: Specialisation Computational Engin | | | |
| | International Management and Engineering: Specialis | • | ulcon | |

| Course L1204: Steel and Con | nposite Structures | | |
|-----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | | | |
| Workload in Hours | ndependent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Marcus Rutner | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Local-buckling of plated structures Warping torsion Composite-girders, -columns, -slabs, -bridges Principles in composite constructions Bridge-design and -construction | | |
| Literature | Petersen, C.: Stahlbau, 4.Auflage 2013, Springer-Vieweg Verlag Minnert, J. Wagenknecht, G.: Verbundbau-Praxis - Berechnung und Konstruktion nach Eurocode 4, 2.Auflage 2013, Bauwerk Beuth Verlag | | |

| Course L1205: Steel and Con | ourse L1205: Steel and Composite Structures | | | | |
|-----------------------------|---|--|--|--|--|
| Тур | Recitation Section (large) | | | | |
| Hrs/wk | 2 | | | | |
| СР | 2 | | | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | | | |
| Lecturer | Prof. Marcus Rutner | | | | |
| Language | DE | | | | |
| Cycle | WiSe | | | | |
| Content | See interlocking course | | | | |
| Literature | See interlocking course | | | | |

| Course L1097: Steel Bridges | | | | |
|-----------------------------|--|--|--|--|
| Тур | Lecture | | | |
| Hrs/wk | 2 | | | |
| СР | 2 | | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | | |
| Lecturer | Yves Freundt | | | |
| Language | | | | |
| Cycle | | | | |
| Content | Lecture Contents ,Steel Bridge Construction' DrIng. Jörg Ahlgrimm | | | |
| | Drnig. Jorg Angrinnin | | | |
| | - From tendering and contracting to completion - the development of a steel bridge | | | |
| | - Contents of a bridge static - structural details, examples of analysis in detail: | | | |
| | -> effective width in regard to the longitudinal stiffeners | | | |
| | -> Bearing point, bearing stiffener | | | |
| | -> Crossbeam breakthrough, crossbeam reinforcement | | | |
| | -> Analysis of the Rib-to-Floorbeam (RF) connection (web-tooth of the floorbeam between trapezoidal shaped Ribs) | | | |
| | Steel grades, -designation, testing methods and approval certificates | | | |
| | Nondestructive weld inspecting | | | |
| | - Corrosion protection | | | |
| | - Bridge bearing - types, format, function, dimensioning, installation | | | |
| | - Expansion Joints | | | |
| | - Oscillation of bridge hangers and cables - oscillation damper | | | |
| | - Opening bridges- Detailed reviews to different assembling procedures and - implements | | | |
| | - Selective damage events | | | |
| | Requirements: Basic knowledge in the calculation, dimensioning, and construction of structural elements and joints of constructional steelwork | | | |
| Literature | | | | |
| | Herbert Schmidt, Ulrich Schulte, Rainer Zwätz, Lothar Bär: Ausführung von Stahlbauten | | | |
| | Petersen, Christian: Stahlbau, Abschnitt Brückenbau | | | |
| | Ahlgrimm, J., Lohrer, I.: Erneuerung der Eisenbahnüberführung in Fulda-Horas über die Fulda, Stahlbau 74 (2005), Heft 2, S. 114 | | | |

| Courses | |
|--|--|
| Fitle Construction Robotics (L2867) | Typ Hrs/wk CP Project-/problem-based Learning 6 6 |
| Module Responsible | Prof. Kay Smarsly |
| Admission Requirements | None |
| Recommended Previous | Basics of project-oriented programming |
| Knowledge | |
| | After taking part successfully, students have reached the following learning results |
| Professional Competence | |
| Knowledge | Basics of robotics |
| | Applications in civil engineering |
| | Kinematics |
| | |
| Skills | Use of specific hardware |
| | Development of software routines |
| | Python programming language |
| | Image processing |
| | Basics of localization (LIDAR, SLAM) |
| Personal Competence | |
| Social Competence | Teamwork |
| | Communication skills |
| | |
| Autonomy | Independent work |
| | Independent decisions |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 |
| Credit points | 6 |
| Course achievement | None |
| Examination | |
| Examination duration and | |
| scale | |
| - | Civil Engineering: Specialisation Structural Engineering: Elective Compulsory |
| Following Curricula | Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory |
| | Civil Engineering: Specialisation Coasta Engineering: Elective Compulsory |
| | Civil Engineering: Specialisation Computational Engineering: Elective Compulsory |
| | Computer Science: Specialisation II: Intelligence Engineering: Elective Compulsory |
| | Mechatronics: Core Qualification: Elective Compulsory |
| | Theoretical Mechanical Engineering: Specialisation Robotics and Computer Science: Elective Compulsory |

| Тур | Project-/problem-based Learning | | | |
|-------------------|--|--|--|--|
| Hrs/wk | 6 | | | |
| СР | | | | |
| Workload in Hours | dependent Study Time 96, Study Time in Lecture 84 | | | |
| Lecturer | of. Kay Smarsly, Jan Stührenberg | | | |
| Language | EN | | | |
| Cycle | WiSe | | | |
| Content | Introduction: Robotics in civil engineering Presentation of potential topics Programming of algorithms in Python Application of software systems: LINUX distribution, ROS, CloudCompare, Application of hardware systems: Petoi Bittle Dog, Raspberry Pi, Arduino, sensing Topics considered for robotics using the Petoi Bittle Dog: Movement Use of sensors (camera, infrared,) Data structures/data acquisition Programming Topics technically relevant to building inspection: Geodetic evaluations Image processing Localization | | | |
| Literature | Bock/Linner: Construction Robotics | | | |
| | Verl et al.: Soft Robotics | | | |
| | Pasquale: New Laws of robotics | | | |

| Courses | | | | |
|---|---|--|--------|----|
| Title | | Тур | Hrs/wk | СР |
| Digital Twinning in Civil Engineerin | g (L3136) | Lecture | 2 | 2 |
| Digital Twinning in Civil Engineering (L3137) | | Seminar | 2 | 4 |
| Module Responsible | Alexander Chmelnizkij | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students ha | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | | | | |
| Skills | | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | | | | |
| Workload in Hours | Independent Study Time 124, Study Time | e in Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Presentation | | | |
| Examination duration and | 20 min presentation and 5 pages handou | t | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Computa | tional Engineering: Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Coastal E | Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Geotech | nical Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Structure | al Engineering: Elective Compulsory | | |

| Course L3136: Digital Twinning in Civil Engineering | | | | |
|---|--|--|--|--|
| Тур | Lecture | | | |
| Hrs/wk | 2 | | | |
| СР | 2 | | | |
| Workload in Hours | dent Study Time 32, Study Time in Lecture 28 | | | |
| Lecturer | Alexander Chmelnizkij, Prof. Bastian Oesterle, Prof. Kay Smarsly | | | |
| Language | DE | | | |
| Cycle | SoSe | | | |
| Content | | | | |
| Literature | | | | |

| Course L3137: Digital Twinn | Course L3137: Digital Twinning in Civil Engineering | | |
|-----------------------------|--|--|--|
| Тур | Seminar | | |
| Hrs/wk | 2 | | |
| СР | 4 | | |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 | | |
| Lecturer | Alexander Chmelnizkij, Prof. Bastian Oesterle, Prof. Kay Smarsly | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | |
|---|---|---|---------------------|-------------|
| Title | | Тур | Hrs/wk | СР |
| Design of Prestressed Structures and Concreet Bridges (L0603) | | Lecture | 3 | 4 |
| Design of Prestressed Structures a | nd Concreet Bridges (L0604) | Recitation Section (large) | 2 | 2 |
| Module Responsible | NN | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Detailed knowledge on the design of concr | rete structures. | | |
| Knowledge | Madulaa, Dainfanaad Cananata Churchuraa I | U. Chrysteinel Analysia I. U. Mashanina I. U. Conser | -t- Church uno - | |
| | Modules: Reinforced Concrete Structures I | +II, Structural Analysis I+II, Mechanics I+II, Concre | ate Structures | |
| Educational Objectives | After taking part successfully, students have reached the following learning results | | | |
| Professional Competence | | | | |
| Knowledge | The students know the main bridge types, their applications and the various loads. They can explain the basic design method | | | |
| | They can explain the design of a prestressed bridge. | | | |
| CI-ill- | | | | |
| SKIIIS | The students are able to design reinforced or prestressed concrete bridges. | | | |
| Personal Competence | | | | |
| Social Competence | The students can design in teamwork a rea | al concrete bridge. | | |
| 4 | The students are able to desire a grant | | | |
| Αυτοποτηγ | The students are able to design a prestres | sed concrete bridge and discuss the problems and | i results with othe | r students. |
| Workload in Hours | Independent Study Time 110, Study Time | in Lecture 70 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 180 minutes | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural | Engineering: Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Computational Engineering: Elective Compulsory | | | |
| | International Management and Engineering | | | |

| Course L0603: Design of Pre | stressed Structures and Concreet Bridges |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | NN |
| Language | DE |
| Cycle | SoSe |
| Content | prestressed structures |
| | basis of prestressed structures, field of application differences between reinforced and prestressed concrete structures history of prestressing construction materials: concrete, tendons, ducts, anchorage systems construction: prestressing methods prestressing forces and member forces (friction, elongation) tendon layout time dependant prestressing losses design of prestressed structures design of anchorage region non-bonded prestressing prestressed flat slabs |
| | Concrete bridges history of bridges design of bridges loads on bridges loads on bridges member forces for slab, T-beam, hollow box, frame and arch bridges precast bridges - precast segmental bridges bearings abutments, columns construction methods damages - checking of bridges |
| Literature | Vorlesungsumdruckim STUDiP Rombach, G. (2003): Spannbetonbau. Ernst & Sohn, Berlin Wicke, M. (2002): Anwendung des Spannbetons. Betonkalender 2002, Teil II, S. 113-180, Verlag Ernst & Sohn, Berlin Leonhardt, F. (1980): Vorlesungen über Massivbau. Teil 5: Spannbeton. Berlin Mehlhorn, G. (2007): Handbuch Brücken, Springer Verlag Schäfer, H.; Kaufeld, K. (1997): Massivbrücken. Betonkalender Teil II, S. 443ff, Ernst & Sohn, Berlin Menn, Ch. (1986): Stahlbetonbrücken. Springer Verlag, Wien |

| Course L0604: Design of Pre | ourse L0604: Design of Prestressed Structures and Concreet Bridges | | | |
|-----------------------------|--|--|--|--|
| Тур | Recitation Section (large) | | | |
| Hrs/wk | 2 | | | |
| СР | 2 | | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | | |
| Lecturer | NN | | | |
| Language | DE | | | |
| Cycle | SoSe | | | |
| Content | See interlocking course | | | |
| Literature | See interlocking course | | | |

| | lechanics and -Dynamics | | | | |
|--|--|---|-------------------------|--------------------|--|
| Courses | | | | | |
| Title | | Тур | Hrs/wk | СР | |
| Soil Mechanics - Selected Topics (L0374) | | Lecture | 2 | 2 | |
| Soil Dynamics (L0452) | | Lecture | 2 | 2 | |
| Experimental Researches in Geote | hnics (L0706) | Practical Course | 2 | 2 | |
| Module Responsible | Prof. Jürgen Grabe | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Modules: Mathematics I-III, Mechanics I-II, Ge | otechnics I | | | |
| Knowledge | Courses: Soil laboratory course, (Applied stru | ctural dynamics) | | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | Students will be able to, | | | | |
| | describe wave propagation in the ground under dynamic excitation and define the relevant parameters, to measure vibrations and to interpret the data obtained with regard to their effect on people and structures, justify when elastodynamic methods are sufficient and when plastodynamic effects must be taken into account, to reproduce the collapse theorems of plasticity theory, describe the viscous behavior of cohesive soils and computationally account for creep deformation and rate-depresent strengths as well as to determine the effect of partial saturation on the seepage flow and the shear strength. | | | tures, account, | |
| Skills | /s After the successful completion of the module the students should be able to: | | | | |
| | to derive and apply the basic equation | of a simple mass oscillator | | | |
| | to derive and apply the basic equation of a simple mass oscillator, to understand the wave propagation in the soil under dynamic excitation and to detect the relevant paramete | | | | |
| | to know the essential laboratory and field tests to determine soil dynamic characteristics and to evaluate them, to design machine foundations to dynamic load, | | | | |
| | | | | | |
| | to measure shocks to perform vibratio | | | | |
| | to evaluate shocks in terms of their effective | | | | |
| | to evaluate possibilities of isolation, | | | | |
| | to understand mechanisms that cause | earthquakes and evaluate earthquakes in | terms of their magnitu | ide and intensity, | |
| | to know methods to determine axial p | ile capacity, integrity, and the dynamic be | dding modulus, | | |
| | to know the mechanisms that lead to mathematically, | a deformation accumulation due to cyclic | loading and to estimat | e these deformatio | |
| | to distinguish the area of application of | f the method of elastodynamics and plasto | odynamics, | | |
| | to detect the undrained shear strength | n as a function of a number of state variab | les, | | |
| | calculations, | nesive soils and to consider the effects of | creep and rate-depend | ent shear strength | |
| | to consider the impact of the partly sa | turated of a seepage and shear strength. | | | |
| Personal Competence | | | | | |
| Social Competence | Students will be able to work in teams to ac | hieve results on measurement and exper | rimental principles and | present their resu | |
| | together at the end of the semester. | | | | |
| Autonomy | Students are able to assess their own strengt | hs and weaknesses and organize their tim | e and learning manage | ement based on thi | |
| Workload in Hours | Independent Study Time 96, Study Time in L | ecture 84 | | | |
| Credit points | 6 | 2 | | | |
| Course achievement | Compulsory Bonus Form Yes None Subject theoretical | Description and | | | |
| Eveninet' | practical work | | | | |
| Examination | Written exam | | | | |
| Examination duration and scale | 135 min | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Er | ngineering: Elective Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnica | | | | |
| 3 • • • • • | Civil Engineering: Specialisation Coastal Engi | | | | |
| | Civil Engineering: Specialisation Computation | | | | |

| Course L0452: Soil Dynamics | | |
|-----------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | ependent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Anne Hagemann | |
| Language | DE | |
| Cycle | SoSe | |
| Content | • mass-spring-damper systems, | |
| | • wave propagation in soils, | |
| | • dynamic soil parameters, | |
| | Determination of dynamic soil parameters, | |
| | • machine foundations, | |
| | • in-situ measurement of ground motion, ground motion prediction, evaluation of ground motion, | |
| | • ground motion shielding, | |
| | introduction into earthquake engineering, | |
| | • dynamic pile tests, | |
| | • cyclic accumulation, | |
| | • plastodynamics | |
| Literature | Das B.M.: Fundamentals of Soil Dynamics, Elsevier Empfehlungen des Arbeitskreises Baugrunddynamik. Hrsg. Deutsche Gesellschaft für Geotechnik (DGGT) Haupt W.: Bodendynamik. Vieweg und Teubner Meskouris K. und Hinzen KG.: Bauwerke und Erdbeben. Vieweg Verlag Studer J.A., Koller M.G. und Laue J.: Bodendynamik, Springer Verlag | |

| Course L0706: Experimental | Researches in Geotechnics |
|----------------------------|--|
| Тур | Practical Course |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Hans Mathäus Stanford, Göta Bürkner |
| Language | DE |
| Cycle | SoSe |
| Content | The students are supposed to: |
| | become acquainted with geotechnical model tests, field tests and laboratory tests as well as corresponding measurement techniques. These compromise amongst others inclinometer measurements and geophone measurements as well as high-grade laboratory tests on the stress-strain relationship of soil specimens, e. g. triaxial tests, simple shear tests and resonant column tests. gain insight into current soil mechanical research. plan, coordinate, perform and evaluate soil mechanical tests in a team. discuss, reflect, review and present the obtained results in a group. An important learning target is the introduction to scientific work for students who plan a scientific career, and for those who will work in practice with the responsibility to order corresponding tests and evaluate the results. The practical laboratory work is based on annualy changing problems, which are however related to the experience and results of the preceding year's course group. |
| Literature | - Grabe, J. (2004): Bodenmechanik und Grundbau, Band 3 der Veröffentlichungsreihe des Instituts für Geotechnik und Baubetrieb, Technische Universität Hamburg-Harburg. |
| | - Kolymbas, D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. 2., korrigierte und ergänzte Auflage, Springer Verlag. |
| | Normen zu geotechnischen Versuchsgeräten und Versuchsverfahren: DIN 18135:2012-04: Baugrund, Untersuchung von Bodenproben - Eindimensionaler Kompressionsversuch, Deutsches Institut für Normung, e. V. |
| | - DIN 18137-2:2011-04: Baugrund, Untersuchung von Bodenproben - Bestimmung der Scherfestigkeit - Teil 2: Triaxialversuch, Deutsches Institut für Normung e. V. |

| Module M0827: Mode | ling in Water Management | | | |
|---|---|--|----------------|----------------------|
| | | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Groundwater Modeling using Modfl | | Lecture | 1 | 1 |
| Groundwater Modeling using Modfle Modeling of Water Supply Network | | Recitation Section (small) Project-/problem-based Learnin | 2 q 2 | 2 3 |
| Module Responsible | | Floject-problem-based Leannin | y z | 5 |
| Admission Requirements | | | | |
| Recommended Previous | | | | |
| Knowledge | | | | |
| j- | groundwater hydraulics and transport or | fsubstances | | |
| | Pipe Systems | | | |
| | | | | |
| | | ures, in particular drinking water systemsand | urban drainag | le systems including |
| | special structuresHydraulics of drinking water supply syst | ems and sewer systems | | |
| | Basic knowledge on water management | | | |
| | | | | |
| | After taking part successfully, students have re | eached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | | g of groundwater flow and transport as well as | | |
| | | chnical and conceptual weak points within the s | ystems in case | studies. Besides the |
| | are able to analyse interdependencies of hydra | aulic and toxic phenomena in soil and water. | | |
| | | | | |
| Chille | The shudents are able to construct and early | | | |
| SKIIIS | kills The students are able to construct and apply scientific groundwater models indipendently. They can work on differe | | | |
| | and can compare or assess different solutions for existing problems by application of selected software products. The st able to use different software solutions (e.g. EPANET, EPA-SWMM). | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Wird nicht vermittelt. | | | |
| Autonomy | Wird nicht vermittelt. | | | |
| | | | | |
| | Independent Study Time 110, Study Time in Le | ecture /0 | | |
| Credit points Course achievement | | | | |
| | | | | |
| | Oral exam 30 min | | | |
| scale | | | | |
| | Civil Engineering: Specialisation Structural Enc | ineering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Scructural Engineering: Specialisation Geotechnical | | | |
| J | Civil Engineering: Specialisation Coastal Engin | | | |
| | Civil Engineering: Specialisation Water and Tra | | | |
| | Civil Engineering: Specialisation Computationa | | | |
| | Water and Environmental Engineering: Special | isation Environment: Elective Compulsory | | |
| | Water and Environmental Engineering: Special | isation Cities: Elective Compulsory | | |
| | Water and Environmental Engineering: Special | isation Water: Elective Compulsory | | |

| Course L0543: Groundwater | Course L0543: Groundwater Modeling using Modflow | | |
|---------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Sonja Götz | | |
| Language | DE/EN | | |
| Cycle | SoSe | | |
| Content | Introduction and application of the groundwater model MODFLOW (PMWIN); theoretical backround of the modell, students do work | | |
| | with the model PMWIN for practical case studies. | | |
| Literature | MODFLOW-Handbuch | | |
| | Chiang, Wen Hsien: PMWIN | | |
| | | | |

| Course L0544: Groundwater | urse L0544: Groundwater Modeling using Modflow | |
|---------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Sonja Götz | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L0875: Modeling of Water Supply Network | | |
|--|--|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 2 | |
| CP | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Dr. Klaus Johannsen | |
| Language | DE | |
| Cycle | SoSe | |
| Content | | |
| Literature | Mutschmann/Stimmelmayr: Taschenbuch der Wasserversorgung, 16. Auflage. Springer Vieweg - Verlag. Wiesbaden 2014. | |

| Courses | | | | |
|---|---|--|-----------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Noise Protection (L1109) Urban Infrastructures (L0874) | | Lecture Project-/problem-based Learning | 2 2 | 2 4 |
| | | Project-/problem-based Learning | Z | 4 |
| • | Dr. Dorothea Rechtenbach | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Knowledge on Urban planning | | | |
| Knowledge | Knowledge on measures for climate protection | | | |
| | General knowledge of scientific writing/working | | | |
| | | | | |
| | After taking part successfully, students have reached the following | ng learning results | | |
| Professional Competence | | | | |
| Knowledge | Students can describe urban development corridors as well as co | urrent and future urban environr | mental probler | ns. They are able |
| | explain the causes of environmental problems (like noise). | | | |
| | Students can specify applications for various technical innovatio | | bute to the im | provement of urb |
| | life. They can, for example, derive and discuss measures for effe | ctive noise abatement. | | |
| Skills | Ils Students are able to develop specific solutions for correcting existing or future environment-related problem | | problems of urb | |
| | development. They can define a range of conceptual and technical solutions for environmental problems for different deve paths. To solve specific urban environmental problems they can select technical innovations and integrate them into the | | | |
| | | | | hem into the urb |
| | context. | | | |
| Personal Competence | | | | |
| Social Competence | The students can work together in international groups. | | | |
| A 4 | | | | |
| Autonomy | Students are able to organize their work flow to prepare themse | | ributions to tr | ie discussions. Tr |
| | can acquire appropriate knowledge by making enquiries indepen | dently. | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | Written Report plus oral Presentation | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Elective | Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Electi | ve Compulsory | | |
| | Civil Engineering: Specialisation Coastal Engineering: Elective Co | mpulsory | | |
| | Civil Engineering: Specialisation Water and Traffic: Elective Comp | oulsory | | |
| | Environmental Engineering: Core Qualification: Elective Compuls | ory | | |
| | Joint European Master in Environmental Studies - Cities and Susta | ainability: Core Qualification: Cor | mpulsory | |
| | Logistics, Infrastructure and Mobility: Specialisation Infrastructure | e and Mobility: Elective Compuls | ory | |
| | | | | |
| | Water and Environmental Engineering: Specialisation Environment | nt: Elective Compulsory | | |

| Course L1109: Noise Protection | | |
|--------------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Martin Jäschke | |
| Language | EN | |
| Cycle | SoSe | |
| Content | | |
| Literature | 1) Müller & Möser (2013): Handbook of Engineering Acoustics (also available in German) | |
| | 2) WHO (1999): Guidelines for Community Noise | |
| | 3) Environmental Noise Directive 2002/49/EG | |
| | 4) ISO 9613-2 (1996): Acoustics, Attenuation of sound during propagation outdoors, Part 2: General method of calculation | |

| Course L0874: Urban Infrast | urse L0874: Urban Infrastructures | | |
|-----------------------------|---|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 2 | | |
| СР | 4 | | |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 | | |
| Lecturer | Dr. Dorothea Rechtenbach | | |
| Language | EN | | |
| Cycle | SoSe | | |
| Content | Problem Based Learning | | |
| | Main topics are: | | |
| | Central vs. Decentral Wastewater Treatment. | | |
| | Compaction of Cities. | | |
| | Car Free Cities. | | |
| | Multifunctional Places in Cities. | | |
| | The Sustainability of Freight Transport in Cities. | | |
| | | | |
| Literature | Depends on chosen topic. | | |

| Courses | | | | |
|-------------------------------------|---|--------------------------------------|----------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Harbour Engineering (L0809) | | Lecture | 2 | 2 |
| Harbour Engineering (L1414) | | Project-/problem-based Learning | 1 | 2 |
| Port Planning and Port Construction | n (L0378) | Lecture | 2 | 2 |
| Module Responsible | Prof. Peter Fröhle | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basics of coastal engineering | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the follo | wing learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are able to define in details and to choose desi | gn approaches for the functional c | lesign of a po | rt and apply ther |
| | design tasks. They can design the fundamental elements of a port. | | | |
| Chille | The students are able to calest and apply appropriate approach | has for the functional design of no | rta | |
| SKIIIS | The students are able to select and apply appropriate approac | thes for the functional design of po | rts. | |
| Personal Competence | | | | |
| Social Competence | The students are able to deploy their gained knowledge in a | pplied problems such as the funct | tional design | of ports. Addition |
| | they will be able to work in team with engineers of other disci | olines. | | |
| Autonomy | The students will be able to independently extend their knowledge | edge and apply it to new problems | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | The duration of the examination is 150 min. The examination | on includes tasks with respect to | the general u | understanding of |
| scale | lecture contents and calculations tasks. | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Electi | ve Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Ele | ctive Compulsory | | |
| | Civil Engineering: Specialisation Coastal Engineering: Compuls | sory | | |
| | Civil Engineering: Specialisation Water and Traffic: Elective Co | mpulsory | | |
| | International Management and Engineering: Specialisation II. | Civil Engineering, Elective Compute | | |

| Тур | Lecture |
|-------------------|---|
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Peter Fröhle |
| Language | DE |
| Cycle | SoSe |
| Content | Fundamentals of harbor engineering Maritime transportation and waterways engineering Ships Elements of harbors Harbor approaches and water-side harbor areas Terminal design and handling of cargo Quay-walls and piers Equipment of harbors Sluices and other special constructions Connection to inland transportation / inland waterway transportation Protection of harbors Breakwaters and Jetties Wave protection of harbors Fishery and other small harbors |
| Literature | Brinkmann, B.: Seehäfen, Springer 2005 |

| Course L1414: Harbour Engi | urse L1414: Harbour Engineering | |
|----------------------------|---|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Peter Fröhle | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| тур | ecture | |
|-------------------|---|--|
| Hrs/wk | 2 | |
| СР | 2 | |
| Vorkload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Frank Feindt | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Planning and implementation of major projects Market analysis and traffic relations Planning process and plan Port planning in urban neighborhood Development of the logistics center "Port of Hamburg" in the metropolis Quays and waterfront structure Special planning Law Harbor - securing of a flexible use of the port Dimensioning of quays Flood protection structures Port of Hamburg - Infrastructure and development Preparation of areas Scour formation in front of shore structures | |

| Courses | | | | |
|-------------------------------------|--|---------------------------------------|-----------------|---------------------|
| Title | | Түр | Hrs/wk | СР |
| Hydraulic Models (L0813) | | Project-/problem-based Learning | 1 | 1 |
| Modelling of Waves (L0812) | | Project-/problem-based Learning | 1 | 1 |
| Modelling of Flow in Rivers and Est | uaries (L0810) | Lecture | 3 | 4 |
| Module Responsible | Prof. Peter Fröhle | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Coastal Hydraulic Engineering I | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the fo | llowing learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to define in detail the basic processes | that are related to the modelling | of flows in hy | ydraulic engineerir |
| | Besides, they can describe the basic aspects of numerical | modelling and actual numerical mod | els for the sir | mulation of flows a |
| | waves. | | | |
| Skills | Students are able to apply hydrodynamic-numerical models | to practical hydraulic engineering ta | ckc | |
| JKIIIS | students are usic to apply hydrodynamic-namencul models | to practical hydraulic engineering ta | 585. | |
| Personal Competence | | | | |
| Social Competence | The students are able to deploy their gained knowledge in | simple applied problems. Additionaly | , they will be | able to work in tea |
| | with others. | | | |
| Autonomy | The students will be able to independently extend their kno | wledge and apply it to new problems | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | The duration of the examination is 3 hours. The examination | ation includes tasks with respect to | the general ι | understanding of t |
| scale | lecture contents and calculations tasks. | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Electronic | ctive Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: | Elective Compulsory | | |
| | Civil Engineering: Specialisation Coastal Engineering: Electiv | ve Compulsory | | |
| | Civil Engineering: Specialisation Computational Engineering | Compulson | | |

| Course L0813: Hydraulic Mod | Course L0813: Hydraulic Models | |
|-----------------------------|--|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Peter Fröhle | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | Fundamentals of hydraulic models Model laws Pi theorem of Buckingham Practical examples of hydraulic models | |
| Literature | Strobl, Zunic: Wasserbau, Kap. 11 Hydraulische Modelle, Springer | |

| Course L0812: Modelling of | Waves |
|----------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Peter Fröhle |
| Language | DE/EN |
| Cycle | SoSe |
| Content | Waves, interactions with shallow water and constructions Wave theories Sea state and surges Development of waves Wave spectra Modelling of Waves / phase averaged and phase resolved models Application of a phase averaged model for wave prediction (SWAN) Application of phase resolved wave models (Mike) |
| Literature | Vorlesungsumdruck |

| Course L0810: Modelling of F | Flow in Rivers and Estuaries |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| CP | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Edgar Nehlsen, Prof. Peter Fröhle |
| Language | EN |
| Cycle | |
| | Introduction to numerical flow modelling |
| | Processes affecting tht flow Examples and applications of numerical models Procedure of numerical modelling Model concept Basic equations of hydrodynamics |
| | Saint-Venant equations |
| | Euler Equations |
| | Navier-Stokes equations |
| | Reynolds-averaged Navier-Stokes equations |
| | Shallow water equations |
| | |
| | Solving schemes |
| | |
| | Numerical discretization |
| | Solution algorithms |
| | Convergence |
| | |
| | |
| Literature | Vorlesungsskript |
| | |
| | Literaturempfehlungen |
| | |
| | Bund der Ingenieure für Wasserwirtschaft, Abfallwirtschaft und Kulturbau (1997): Hydraulische Berechnung von naturnahen |
| | Fließgewässern. Düsseldorf: BWK (BWK-Merkblatt). |
| | Chow, Ven-te (1959): Open-channel Hydraulics. New York usw.: McGraw-Hill (McGraw-Hill Civil Engineering Series). |
| | |
| | Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (DWA); DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische Modelle, DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische (2019a): Merkblatt DWA-M 543-2 Geodaten in der Fließgewässermodellierung Teil 1: Geodaten in der Fließgewässermodellierung. Februar 2019. Hennef: Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall (DWA-Regelwerk, 543-1). |
| | Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (DWA); DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische Modelle, DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische (2019b): Merkblatt DWA-M 543-2 Geodaten in de Fließgewässermodellierung Teil 2: Bedarfsgerechte Datenerfassung und -aufbereitung. Februar 2019. Hennef: Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall (DWA-Regelwerk, 543-2). |
| | Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (DWA); DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische Modelle, DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische (2019c): Merkblatt DWA-M 543-3 Geodaten in de Fließgewässermodellierung - Teil 3: Aspekte der Strömungsmodellierung und Fallbeispiele. Februar 2019. Hennef: Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall (DWA-Regelwerk, 543-3). |
| | Hervouet, Jean-Michel (2007): Hydrodynamics of free surface flows. Modelling with the finite element method. Chichester: Wiley Online verfügbar unter http://www.loc.gov/catdir/enhancements/fy0741/2007296953-b.html. |
| | IAHR (2015): Professional Specifications for Physical and Numerical Studies in Environmental Hydraulics. In: Hydrolink (3/2015), S 90-92. |
| | Olsen, Nils Reidar B. (2012): Numerical Modelling and Hydraulics. 3. Aufl. Department of Hydraulic and Environmental Engineering The Norwegian University of Science and Technology. |
| | Szymkiewicz, Romuald (2010): Numerical modeling in open channel hydraulics. Dordrecht: Springer (Water science and technology library, 83). |
| | van Waveren, Harold (1999-): Good modelling practice handbook. [Utrecht], Lelystad, Den Haag: STOWA; Rijkswaterstaat-RIZA SDU, afd. SEO/RIZA [etc. distr.] (Nota, nr. 99.036). |
| | Zielke, Werner (Hg.) (1999): Numerische Modelle von Flüssen, Seen und Küstengewässern. Deutscher Verband für Wasserwirtschaft und Kulturbau. Bonn: Wirtschafts- und VerlGes. Gas und Wasser (Schriftenreihe des Deutschen Verbandes für Wasserwirtschaft und Kulturbau, 127). |

| Module M0874: Waste | ewater Systems | | | | |
|--|---|-------------------------------|-----------------------------------|-------------------|--------------------|
| - | - | | | | |
| Courses | | | | | |
| Title | | Ту | | Hrs/wk | СР |
| Biological Wastewater Treatment (L0517) | | | cture | 2 | 2 |
| Biological Wastewater Treatment (| | | citation Section (large) | 1 2 | 1 2 |
| Advanced Wastewater Treatment (Advanced Wastewater Treatment (| | | cture citation Section (large) | 2 | 2 |
| Module Responsible | | ne | citation Section (large) | Ŧ | Ŧ |
| Admission Requirements | None | | | | |
| | Knowledge of wastewater management | and the key processes invol | ved in wastewater treatr | nent | |
| Knowledge | Knowledge of wastewater management | and the key processes invol | ved in wastewater treati | nent. | |
| | After taking part successfully, students h | any reached the following l | oproing results | | |
| | After taking part successfully, students h | lave reached the following i | earning results | | |
| Professional Competence | | | | | |
| Knowledge | Students are able to outline key areas o | - | • | - | |
| | dependence for sustainable water protect | ction. They can describe rele | evant economic, environi | mental and social | factors. |
| Skills | Students are able to pre-design and explain the available wastewater treatment processes and the scope of their application i | | | | |
| | municipal and for some industrial treatment plants. | | | | |
| | | | | | |
| Personal Competence | | | | | |
| Social Competence | Social skills are not targeted in this mode | ule. | | | |
| Autonomy | Students are in a position to work on a | a subject and to organize t | their work flow indepen | dently They can | also present on th |
| , lacenemy | subject. | | anen ment neu maepen | | |
| | | | | | |
| Workload in Hours | Independent Study Time 96, Study Time | in Lecture 84 | | | |
| Credit points | | | | | |
| Course achievement | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and | 120 min | | | | |
| scale | | | | | |
| Assignment for the | Civil Engineering: Specialisation Structur | ral Engineering: Elective Cor | mpulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory | | | | |
| | Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory | | | | |
| | Civil Engineering: Specialisation Water and Traffic: Compulsory | | | | |
| | Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory | | | | |
| | Environmental Engineering: Specialisation Water Quality and Water Engineering: Elective Compulsory | | | | |
| | International Management and Engineering: Specialisation II. Process Engineering and Biotechnology: Elective Compulsory | | | | |
| | International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory | | | | |
| | Process Engineering: Specialisation Envi | ronmental Process Engineer | ing: Elective Compulsory | / | |
| | Process Engineering: Specialisation Proc | ess Engineering: Elective Co | ompulsory | | |
| | Water and Environmental Engineering: S | Specialisation Water: Compu | llsory | | |
| | Water and Environmental Engineering: S | Specialisation Environment: | Elective Compulsory | | |
| | Water and Environmental Engineering: S | Specialisation Cities: Compu | lsory | | |

| Course L0517: Biological Wastewater Treatment | |
|---|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Joachim Behrendt |
| Language | DE/EN |
| Cycle | SoSe |
| Content | Charaterisation of Wastewater |
| | Metobolism of Microorganisms |
| | Kinetic of mirobiotic processes |
| | Calculation of bioreactor for wastewater treatment |
| | Concepts of Wastewater treatment |
| | Design of WWTP |
| | Excursion to a WWTP |
| | Biofilms |
| | Biofim Reactors |
| | Anaerobic Wastewater and sldge treatment |
| | resources oriented sanitation technology |
| | Future challenges of wastewater treatment |
| Literature | Gujer, Willi |
| | Siedlungswasserwirtschaft : mit 84 Tabellen |
| l | |

| ISBN: 3540343296 (Gb.) URL: http://www.gbv.de/dms/bs/toc/516261924.pdf URL: http://deposit.d-nb.de/cgi-bin/dokserv? |
|--|
| id=2842122&prov=M&dok_var=1&dok_ext=htm |
| Berlin [u.a.] : Springer, 2007 |
| TUB_HH_Katalog |
| Henze, Mogens |
| Wastewater treatment : biological and chemical processes |
| ISBN: 3540422285 (Pp.) |
| Berlin [u.a.] : Springer, 2002 |
| TUB_HH_Katalog |
| Imhoff, Karl (Imhoff, Klaus R.;) |
| Taschenbuch der Stadtentwässerung : mit 10 Tafeln |
| ISBN: 3486263331 ((Gb.)) |
| München [u.a.] : Oldenbourg, 1999 |
| TUB_HH_Katalog |
| Lange, Jörg (Otterpohl, Ralf; Steger-Hartmann, Thomas;) |
| Abwasser : Handbuch zu einer zukunftsfähigen Wasserwirtschaft |
| ISBN: 3980350215 (kart.) URL: http://www.gbv.de/du/services/agi/52567E5D44DA0809C12570220050BF25/000000700334 |
| Donaueschingen-Pfohren : Mall-Beton-Verl., 2000 |
| TUB_HH_Katalog |
| Mudrack, Klaus (Kunst, Sabine;) |
| Biologie der Abwasserreinigung : 18 Tabellen |
| ISBN: 382741427X URL: http://www.gbv.de/du/services/agi/94B581161B6EC747C1256E3F005A8143/420000114903 |
| Heidelberg [u.a.] : Spektrum, Akad. Verl., 2003 |
| TUB_HH_Katalog |
| Tchobanoglous, George (Metcalf & Eddy, Inc., ;) |
| Wastewater engineering : treatment and reuse |
| ISBN: 0070418780 (alk. paper) ISBN: 0071122508 (ISE (*pbk)) |
| Boston [u.a.] : McGraw-Hill, 2003 |
| TUB_HH_Katalog |
| Henze, Mogens |
| Activated sludge models ASM1, ASM2, ASM2d and ASM3 |
| ISBN: 1900222248 |
| London : IWA Publ., 2002 |
| TUB_HH_Katalog |
| Kunz, Peter |
| Umwelt-Bioverfahrenstechnik |
| Vieweg, 1992 |
| Bauhaus-Universität., Arbeitsgruppe Weiterbildendes Studium Wasser und Umwelt (Deutsche Vereinigung für |
| Wasserwirtschaft, Abwasser und Abfall, ;) |
| Abwasserbehandlung : Gewässerbelastung, Bemessungsgrundlagen, Mechanische Verfahren, Biologische Verfahren, Reststoffe |
| aus der Abwasserbehandlung, Kleinkläranlagen |
| ISBN: 3860682725 URL: http://www.gbv.de/dms/weimar/toc/513989765_toc.pdf URL: |
| http://www.gbv.de/dms/weimar/abs/513989765_abs.pdf |
| Weimar : Universitätsverl, 2006 |
| TUB_HH_Katalog |
| Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall |
| DWA-Regelwerk |
| Hennef : DWA, 2004 |
| TUB_HH_Katalog |
| Wiesmann, Udo (Choi, In Su; Dombrowski, Eva-Maria;) |
| Fundamentals of biological wastewater treatment |
| ISBN: 3527312196 (Gb.) URL: http://deposit.ddb.de/cgi-bin/dokserv?id=2774611&prov=M&dok_var=1&dok_ext=htm |
| Weinheim : WILEY-VCH, 2007 |
| TUB_HH_Katalog |
| |

| Course L3122: Biological Wa | Course L3122: Biological Wastewater Treatment | |
|-----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dr. Joachim Behrendt | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L0357: Advanced Wa | stewater Treatment |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Joachim Behrendt |
| Language | EN |
| Cycle | SoSe |
| Content | Survey on advanced wastewater treatment |
| | reuse of reclaimed municipal wastewater |
| | Precipitation |
| | Flocculation |
| | Depth filtration |
| | Membrane Processes |
| | Activated carbon adsorption |
| | Ozonation |
| | "Advanced Oxidation Processes" |
| | Disinfection |
| Literature | Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003 |
| | Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987 |
| | Membranverfahren: Grundlagen der Modul- und Anlagenauslegung, T. Melin und R. Rautenbach, Springer-Verlag, Berlin 2007 |
| | Trinkwasserdesinfektion: Grundlagen, Verfahren, Anlagen, Geräte, Mikrobiologie, Chlorung, Ozonung, UV-Bestrahlung, |
| | Membranfiltration, Qualitätssicherung, W. Roeske, Oldenbourg-Verlag, München 2006 |
| | Organische Problemstoffe in Abwässern, H. Gulyas, GFEU, Hamburg 2003 |

| Course L0358: Advanced Wa | stewater Treatment |
|---------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Joachim Behrendt |
| Language | EN |
| Cycle | SoSe |
| Content | Aggregate organic compounds (sum parameters) |
| | Industrial wastewater |
| | Processes for industrial wastewater treatment |
| | Precipitation |
| | Flocculation |
| | Activated carbon adsorption |
| | Recalcitrant organic compounds |
| | |
| Literature | Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003 |
| | Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987 |
| | Membranverfahren: Grundlagen der Modul- und Anlagenauslegung, T. Melin und R. Rautenbach, Springer-Verlag, Berlin 2007 |
| | Trinkwasserdesinfektion: Grundlagen, Verfahren, Anlagen, Geräte, Mikrobiologie, Chlorung, Ozonung, UV-Bestrahlung, Membranfiltration, Qualitätssicherung, W. Roeske, Oldenbourg-Verlag, München 2006 |
| | Organische Problemstoffe in Abwässern, H. Gulyas, GFEU, Hamburg 2003 |

| Courses | |
|--------------------------------|---|
| Title | Typ Hrs/wk CP |
| City Planning (L1066) | Project-/problem-based Learning 4 6 |
| Module Responsible | Prof. Carsten Gertz |
| Admission Requirements | None |
| | for "Principles of Urban Planning": none |
| Knowledge | for "Designing Urban Streetscapes": some knowledge of transport planning, e.g. through taking the undergraduate class "Tran |
| | Planning and Traffic Engineering" |
| | |
| Educational Objectives | After taking part successfully, students have reached the following learning results |
| Professional Competence | |
| Knowledge | Students are able to: |
| | |
| | use technical terms of urban planning. |
| | describe the main determinants of urban development. evaluation and compare different percibilities of here urban development can be influenced. |
| | explain and compare different possibilities of how urban development can be influenced. discuss requirements for public streatscapes |
| | discuss requirements for public streetscapes. explain the importance of street design. |
| | • explain the importance of street design. |
| | |
| Skills | Students are able to: |
| | |
| | read and analyze urban development concepts and designs for streetscapes |
| | appraise such concepts in the context of competing requirements. |
| | design, justify and reflect their own solutions for concrete examples. |
| | |
| Personal Competence | |
| Social Competence | Students are able to: |
| | |
| | discuss intermediate results with each other. |
| | constructively accept feedback on their own work. provide constructive feedback to others. |
| | • provide constructive reedback to others. |
| | |
| Autonomy | Students are able to: |
| , | |
| | independently complete a written report including drawings following a broadly pre-defined process. |
| | assess the consequences of their proposed solutions. |
| | independently acquire knowledge and apply this to new issues or problem areas. |
| | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Credit points | |
| - | |
| Course achievement | None Written elaboration |
| | |
| Examination duration and scale | written assignment, designwork during the semester |
| | Civil Engineering: Specialisation Structural Engineering: Elective Computers |
| - | Civil Engineering: Specialisation Structural Engineering: Elective Compulsory |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory |
| | Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory |
| | Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective Compulsory |
| | Water and Environmental Engineering: Specialisation Environment: Elective Compulsory |
| | Water and Environmental Engineering: Specialisation Cities: Compulsory |

| Course L1066: City Planning | |
|-----------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| СР | 6 |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Lecturer | Prof. Carsten Gertz |
| Language | DE |
| Cycle | SoSe |
| Content | "Principles of Urban Planning" deals with the determinants of urban development and their interactions. Topics include: legal framework, instruments and methods of planning, functional requirements, stakeholders and actors basic design requirements different planning levels and historical contexts. The objective of the course is for students to acquire a basic understanding of urban development problems and approaches for solving them. They will also be able to comprehend the process of urban planning. The course also covers the various functional and aesthetic requirements for designing streetscape as the most important elements of public space. The project work deals with a real life scenario and includes drawing up a development plan, an urban design concept, a building masterplan and a street redesign. |
| Literature | Albers, Gerd; Wekel, Julian (2021) Stadtplanung: Eine illustrierte Einführung. 4. überarbeitete Auflage. Primus Verlag. Darmstadt. |
| | Frick, Dieter (2011) Theorie des Städtebaus: Zur baulich-räumlichen Organisation von Stadt. 3. veränderte Auflage. Wasmuth- Verlag. Tübingen |
| | Jonas, Carsten (2009) Die Stadt und ihr Grundriss. Wasmuth-Verlag. Tübingen Kostof, Spiro; Castillo, Greg (1998) Die Anatomie der Stadt. Geschichte städtischer Strukturen. Campus-Verlag. Frankfurt/New York. |
| | |

| - | | | | | |
|--|--|--------------------------------------|---------------|-----------------------|--|
| Courses | | | | | |
| Title | Тур | 3 | Hrs/wk | СР | |
| Construction Logistics (L1163) | | ture | 1 | 2 | |
| Construction Logistics (L1164) | | itation Section (small) | 1 | 2 | |
| Project Development and Managen Project Development and Managen | | ture ject-/problem-based Learning | 1 | 1 | |
| | | ect-problem-based Learning | T | 1 | |
| Module Responsible Admission Requirements | None | | | | |
| Recommended Previous | none | | | | |
| Knowledge | none | | | | |
| | After taking part successfully, students have reached the following la | arning results | | | |
| | After taking part successfully, students have reached the following le | | | | |
| Professional Competence | Studente con | | | | |
| Knowledge | Students can | | | | |
| | • give definitions of the main terms of construction logistics and | project development and ma | anagement | | |
| | name advantages and disadvantages of internal or external content | onstruction logistics | | | |
| | explain characteristics of products, demand and production of | construction objects and the | eir consequer | nces for construction | |
| | specific supply chains | | | | |
| | differentiate constructions logistics from other logistics system | 15 | | | |
| Skills | Students can | | | | |
| | | | | | |
| | carry out project life cycle assessments | | | | |
| | apply methods and instruments of construction logistics | | | | |
| | apply methods and instruments of project development and m | lanagement | | | |
| | apply methods and instruments of conflict management | | | | |
| | design supply and waste removal concepts for a construction p | project | | | |
| Personal Competence | | | | | |
| Social Competence | Students can | | | | |
| | | | | | |
| | hold presentations in and for groups | | | | |
| | apply methods of conflict solving skills in group work and case | studies | | | |
| Autonomy | Students can | | | | |
| | | | | | |
| | solve problems by holistic, systemic and flow oriented thinking | | | | |
| | improve their creativity, negotiation skills, conflict and crise studies | s solution skills by applying | methods of | moderation in ca | |
| | studies | | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Written elaboration | | | | |
| Examination duration and | Two written papers with presentations | | | | |
| scale | | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Elective Com | ipulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Elective C | Compulsory | | | |
| | Civil Engineering: Specialisation Coastal Engineering: Elective Compu | lsory | | | |
| | Civil Engineering: Specialisation Water and Traffic: Elective Compulse | ory | | | |
| | International Management and Engineering: Specialisation II. Civil En | gineering: Elective Compulso | ory | | |
| | International Management and Engineering: Specialisation II. Logistic | s: Elective Compulsory | | | |
| | Logistics, Infrastructure and Mobility: Specialisation Production and Lo | ogistics: Elective Compulsory | / | | |
| | Logistics, Infrastructure and Mobility: Specialisation Infrastructure and | d Mobility: Elective Compulso | ory | | |

| Course L1163: Construction | Logistics |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Heike Flämig |
| Language | DE |
| Cycle | SoSe |
| Content | The lecture gives deeper insight how important logistics are as a competetive factor for construction projects and which issues are to be adressed. The following toppics are covered: • competetive factor logistics • the concept of systems, planning and coordination of logistics • material, equipment and reverse logistics • IT in construction logistics • elements of the planning model of construction logistics and their connections • flow oriented logistics systems for construction projects • logistics concepts for ready to use construction projects • best practice examples (construction logistics Potsdamer Platz, recent case study of the region) Contents of the lecture are deepened in special exercises. |
| Literature | Flämig, Heike: Produktionslogistik in Stadtregionen. In: Forschungsverbund Ökologische Mobilität (Hrsg.) Forschungsbericht Bd 15.2. Wuppertal 2000. Krauss, Siri: Die Baulogistik in der schlüsselfertigen Ausführung, Bauwerk Verlag GmbH Berlin 2005. Lipsmeier, Klaus: Abfallkennzahlen für Neubauleistungen im Hochbau : Verlag Forum für Abfallwirtschaft und Altlasten, 2004. Schmidt, Norbert: Wettbewerbsfaktor Baulogistik. Neue Wertschöpfungspotenziale in der Baustoffversorgung. In: Klaus, Peter Edition Logistik. Band 6. Deutscher Verkehrs-Verlag. Hamburg 2003. Seemann, Y.F. (2007): Logistikkoordination als Organisationseinheit bei der Bauausführung Wissenschaftsverlag Mainz in Aachen, Aachen. (Mitteilungen aus dem Fachgebiet Baubetrieb und Bauwirtschaft (Hrsg. Kuhne, V.): Heft 20) |

| Course L1164: Construction | Course L1164: Construction Logistics | | |
|----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 1 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Prof. Heike Flämig | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Course L1161: Project Develo | ourse L1161: Project Development and Management | | |
|------------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Heike Flämig, Dr. Anton Worobei | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Within the lecture, the main aspects of project development and management are tought: | | |
| | Terms and definitions of project management | | |
| | Advantages and disadvantages of different ways of project handling | | |
| | organization, information, coordination and documentation | | |
| | cost and fincance management in projects | | |
| | time- and capacity management in projects | | |
| | specific methods and instruments for successful team work | | |
| | Contents of the lecture are deepened in special exercises. | | |
| Literature | Projektmanagement-Fachmann. Band 1 und Band 2. RKW-Verlag, Eschborn, 2004. | | |

| Course L1162: Project Devel | rse L1162: Project Development and Management | | | |
|-----------------------------|---|--|--|--|
| Тур | Project-/problem-based Learning | | | |
| Hrs/wk | 1 | | | |
| СР | 1 | | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | | |
| Lecturer | Prof. Heike Flämig, Dr. Anton Worobei | | | |
| Language | DE | | | |
| Cycle | SoSe | | | |
| Content | See interlocking course | | | |
| Literature | See interlocking course | | | |

| - | | | | | |
|--|---|--|-------------------|-------------------|--|
| Courses | | | | | |
| Title | | Тур | Hrs/wk | СР | |
| Structural Dynamics (L1202) | | Lecture | 2 | 2 | |
| Structural Dynamics (L1203) | | Recitation Section (large) | 2 | 2 | |
| Fracture mechanics and fatigue in | | Lecture | 1 | 1 | |
| Fracture mechanics and fatigue in | | Recitation Section (large) | 1 | 1 | |
| | Prof. Bastian Oesterle | | | | |
| Admission Requirements | | | | | |
| Recommended Previous | Knowledge of linear structural analysis of | of statically determinate and indeterminate structu | ures; Mechanics | I/II, Mathematics | |
| Knowledge | Differential equations I | | | | |
| Educational Objectives | After taking part successfully, students ha | ave reached the following learning results | | | |
| Professional Competence | | | | | |
| • | | le the student can evaluin the basic aspects of d | unamia offecta a | n structures and | |
| Kilowiedge | respective methods. | lle, the student can explain the basic aspects of d | ynanne enects e | in sciuctures and | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| Skille | After successful completion of this may | dule, the students will be able to predict the res | nonco of motor | al and structures | |
| 381115 | | | ponse or mater | | |
| | dynamics loading using the appropriate co | omputational approaches and methods. | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| Personal Competence | | | | | |
| Social Competence | Students can | | | | |
| | participate in subject specific and i | nterdicciplinary discussions | | | |
| | participate in subject-specific and interdisciplinary discussions, defend their own work results in front of others. | | | | |
| | defend their own work results in front of others | | | | |
| | promote the scientific development of colleagues | | | | |
| | Furthermore, they can give and accord | cept professional constructive criticism | | | |
| Autonomu | Students are able to gain knowledge of the | ne subject area from given and other sources and a | pply it to new pr | oblems. Furthermo | |
| Autonomy | they are able to structure the solution process for problems in the area of Structural Analysis. | | | | |
| Autonomy | they are able to structure the solution pro | | | | |
| | | ocess for problems in the area of Structural Analysis. | | | |
| | they are able to structure the solution pro Independent Study Time 96, Study Time i | ocess for problems in the area of Structural Analysis. | | | |
| | Independent Study Time 96, Study Time i | ocess for problems in the area of Structural Analysis. | | | |
| Workload in Hours | Independent Study Time 96, Study Time i 6 | ocess for problems in the area of Structural Analysis. | | | |
| Workload in Hours Credit points Course achievement | Independent Study Time 96, Study Time i 6 | ocess for problems in the area of Structural Analysis. | | | |
| Workload in Hours Credit points Course achievement | Independent Study Time 96, Study Time i 6 None Written exam | ocess for problems in the area of Structural Analysis. | | | |
| Workload in Hours Credit points Course achievement Examination | Independent Study Time 96, Study Time i 6 None Written exam | ocess for problems in the area of Structural Analysis. | · | | |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale | Independent Study Time 96, Study Time i 6 None Written exam | ocess for problems in the area of Structural Analysis. n Lecture 84 | | | |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale | Independent Study Time 96, Study Time i 6 None Written exam 150 min Civil Engineering: Specialisation Structura | n Lecture 84 | | | |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study Time 96, Study Time i 6 None Written exam 150 min Civil Engineering: Specialisation Structura | n Lecture 84 n Lecture 84 Il Engineering: Compulsory nical Engineering: Elective Compulsory | | | |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study Time 96, Study Time i 6 None Written exam 150 min Civil Engineering: Specialisation Structura Civil Engineering: Specialisation Geotechr Civil Engineering: Specialisation Coastal E | n Lecture 84 n Lecture 84 n Engineering: Compulsory nical Engineering: Elective Compulsory ingineering: Elective Compulsory | | | |
| Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | Independent Study Time 96, Study Time i 6 None Written exam 150 min Civil Engineering: Specialisation Structura Civil Engineering: Specialisation Geotechr | n Lecture 84 n Lecture 84 al Engineering: Compulsory nical Engineering: Elective Compulsory ingineering: Elective Compulsory d Traffic: Elective Compulsory | | | |

| Course L1202: Structural Dy | namics | | |
|-----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Bastian Oesterle | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | mechanical background of dynamics harmonic vibrations, damped and undamped free and forced vibrations frequency and time domain modelling aspects principle of d'Alembert systems with multiple degrees of freedom consistent and lumped mass matrices finite elements for dynamics problems impact problems eigenvalue problems and modal analysis direct time integration schemes, transient analyses | | |
| Literature | Vorlesungsmanuskript Clough, R.W., Penzien, J.: Dynamics of Structures. 2. Aufl., McGraw-Hill, New York, 1993. | | |

| Course L1203: Structural Dy | Course L1203: Structural Dynamics | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Bastian Oesterle | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Тур | Lecture |
|-------------------|--|
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Jürgen Priebe |
| Language | DE |
| Cycle | SoSe |
| Content | basics of fatigue stress and fatigue resistance and determination of fatigue strength, |
| | determination and use of S-N-curves and classification of notch effects, |
| | • set up of determination of fatigue strength under dynamic load using the accumulation formula by Palmgren-Miner, |
| | set up of determination of fatigue strength in different examples, |
| | basics of construction and design regarding the problem of material fatigue, |
| | basics of linear elastic fracture mechanics under static and dynamic load, |
| | determination of lifetime of steel construction based on linear elastic fracture mechanics in different examples. |
| Literature | Seeßelberg, C.; Kranbahnen - Bemessung und konstruktive Gestaltung; 3. Auflage; Bauwerk-Verlag; Berlin 2009 |
| | • Kuhlmann, Dürr, Günther; Kranbahnen und Betriebsfestigkeit; in Stahlbau Kalender 2003; Verlag Ernst & Sohn; Berlin 200 |
| | Deutscher Stahlbau-Verband (Hrsg.); Stahlbau Handbuch Band 1 Teil B; 3. Auflage; Stahlbau-Verlagsgesellschaft; Köln 19 |
| | Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993 |
| | DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsr Bemessungsregeln f ür den Hochbau; 1993 |
| | • DIN V ENV 1993-6: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 6: Kranbahnen; 2001 |
| | DIN-Fachbericht 126. Richtlinie zur Anwendung von DIN V ENV 1993-6; Nationales Anwendungsdokument (NAD); Berlin 2 |
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| Course L0565: Fracture mechanics and fatigue in steel structures | | |
|--|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dr. Jürgen Priebe | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

Module M0593: Building Materials and Building Preservation

| Courses | | | | | | |
|------------------------------------|--|-----------------------|-----------------------------------|--------------------|----------------|---------------------|
| Title | | | Тур | | Hrs/wk | СР |
| Repair of Structures (L0255) | | | Lecture | | 1 | 1 |
| Mineral Building Materials (L0253) | | | Lecture | | 2 | 2 |
| Technology of mineral Building Mat | erials (L0256) | | Project-/problem- | based Learning | 1 | 2 |
| Transport Processes in Building Ma | erials and Damage Processes (L02 | 254) | Lecture | | 1 | 1 |
| Module Responsible | Prof. Frank Schmidt-Döhl | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Basic knowledge about building materials, building physics and building chemistry, for example by the modules Principles of | | | | | |
| Knowledge | Building Materials and Building Physics and Building Materials and Building Chemistry. | | | | | |
| Educational Objectives | After taking part successfully, | students have reach | ed the following learning result | ts | | |
| Professional Competence | | | | | | |
| Knowledge | The students are able to descr | ibe the components | of mineral building materials a | nd their function | in detail and | d to use them for t |
| | manufacture of special minera | l building materials. | They are able to show the cha | racteristics of mi | neral building | g materials. They a |
| | able to describe the manufactu | ire, properties and f | ields of application of special n | nortars and spec | ial concretes | and the correlation |
| | of their material parameters. T | hey are able to show | v the principles of anchor techr | nology and desig | n. | |
| Chille | The students are able to perfe | m on optimization of | of aronulomotry of a minoral h | uilding material | They are abl | a ta dacian a chac |
| SKIIIS | The students are able to perform | | • • | - | | • · |
| | mineral mortar and to manufacture this mortar. The students are able to manufacture post installed rebar conr | | | | - | |
| | able to recognize damages, to assess possible causes, to use the fundamentals of construction preservation and to and strengthening measures. | | | and to select rep | | |
| | | | | | | |
| Personal Competence | | | | | | |
| Social Competence | The students are able to devel | | | | | |
| | other students. In a critical discussion they defend and adjust their results. The students are able to manufacture their spec | | | | | |
| | building material on the basis of | of this feedback. | | | | |
| | | | | | | |
| Autonomy | my The students are able to responsibly use the resources of materials and lab equipment for their project and to investigate and | | | | | |
| | get missing components. | | | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | | | |
| Credit points | 6 | | | | | |
| Course achievement | Compulsory Bonus Form | | Description | | | |
| | Yes 20 % Subject | theoretical and | 1 | | | |
| | practica | al work | | | | |
| Examination | Written exam | | | | | |
| Examination duration and | 120 min | | | | | |
| scale | | | | | | |
| Assignment for the | Civil Engineering: Specialisatio | n Geotechnical Engi | neering: Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisatio | n Coastal Engineerin | g: Elective Compulsory | | | |
| | Civil Engineering: Specialisatio | n Structural Enginee | ring: Elective Compulsory | | | |
| | Civil Engineering: Specialisatio | | | | | |

| Course L0255: Repair of Stru | Course L0255: Repair of Structures | | |
|------------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Frank Schmidt-Döhl | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Maintenance of structures, repair and strengthening, subsequent waterproofing of structures | | |
| Literature | BetonMarketing Deutschland (Hrsg.): Stahlbetonoberflächen - schützen, erhalten, instandsetzen | | |

| Course L0253: Mineral Buildi | ing Materials |
|------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Frank Schmidt-Döhl |
| Language | DE |
| Cycle | SoSe |
| Content | Components of mineral building materials and their function, binding materials, concrete and mortar, special mortars, special concretes |
| Literature | Taylor, H.F.W.: Cement Chemistry |
| | Springenschmid, R.: Betontechnologie für die Praxis |

| Course L0256: Technology of | Course L0256: Technology of mineral Building Materials | |
|-----------------------------|--|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Frank Schmidt-Döhl | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Design and production of a special mineral building material | |
| Literature | Taylor, H.F.W.: Cement Chemistry | |
| | Springenschmid, R.: Betontechnologie für die Praxis | |

| Course L0254: Transport Processes in Building Materials and Damage Processes | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Frank Schmidt-Döhl | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Transport Processes in Building Materials and Damage Processes | |
| Literature | Blaich, J.: Bauschäden, Analyse und Vermeidung | |

| Courses | | | | |
|------------------------------------|---|---|---------|----|
| ſitle | | Тур | Hrs/wk | СР |
| Steel Construction Project (L1206) | | Project Seminar | 4 | 6 |
| Module Responsible | Prof. Marcus Rutner | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Steel and Composite Structures | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students ha | ve reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to prepare a part of the | whole project and explain it to the others. | | |
| Skills | Students can produce sketches and calculations of their part of the project. They are able to adjust their work in reaction | | | |
| | changing conditions resulting from other p | articipants of the project. | | |
| Personal Competence | | | | |
| Social Competence | Students can present their results to other | members of the group. | | |
| | They have the ability to work for a broad a | greement with respect to intergroup depende | encies. | |
| | They can distribute and process tasks inde | ependently. | | |
| Autonomy | Students can handle their part of the proje | ect on their own resposibility- | | |
| Workload in Hours | Independent Study Time 124, Study Time | in Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | approx. 15-20 pages (without appendix) | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Geotechn | ical Engineering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Coastal E | | | |
| | Civil Engineering: Specialisation Structura | | | |
| | Civil Engineering: Specialisation Computat | ional Engineering: Elective Compulsory | | |

| Course L1206: Steel Constru | Course L1206: Steel Construction Project | |
|-----------------------------|---|--|
| Тур | Project Seminar | |
| Hrs/wk | 4 | |
| CP | 6 | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | |
| Lecturer | Prof. Marcus Rutner | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Design of a big construction project (i.e skyscraper, large bridge, roof of a stadiuim) in small groups | |
| Literature | Wird je nach Projekt individuell angegeben. | |
| 1 | | |

| Courses | | | | |
|--|---|--|-----------------|-------------------|
| Title | | Тур | Hrs/wk | СР |
| Marine Geotechnics (L0548) | | Lecture | 1 | 2 |
| Marine Geotechnics (L0549) Steel Structures in Foundation and | Hydraulic Engineering (11146) | Recitation Section (large) Lecture | 2 | 2 |
| Module Responsible | | 20000 | - | - |
| Admission Requirements | | | | |
| | Complete modules: Geotechnics I-III, Math | ematics I-III | | |
| Knowledge | • | | | |
| | Courses: Soil laboratory course | | | |
| Educational Objectives | After taking part successfully, students have | ve reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students get a deeper knowledge of steel and ground engineering as well as constructions knowledge concerning quay wall | | | |
| | Furthermore, the students get all the necessary knowledge to design singular construction elements for sheet pile walls and t | | | |
| | know how to choose the right construction elements depending on the influencing conditions. | | | |
| Skille | Furthermore the shudents are able to discover shart all such sets attraction and an threatment and the share d | | | |
| JKIIIS | Is Furthermore, the students are able to dimension sheet pile wall construction regarding all construction elements, to che suitable construction elements with respect to the influencing conditions, to design all kinds of sheet pile walls (wave sh | | | |
| | walls and combined sheet pile walls) and to dimension all construction elements and connections. | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | Students are able to assess their own stren | ngths and weaknesses and organize their time and | learning manage | ement based on th |
| 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 | Civil Engineering: Specialisation Geotechni | ical Engineering: Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Structural | Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Coastal Er | ngineering: Compulsory | | |
| | Civil Engineering: Specialisation Computat | ional Engineering: Elective Compulsory | | |
| | | | | |

| Course L0548: Marine Geote | chnics |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Jürgen Grabe |
| Language | DE |
| Cycle | SoSe |
| Content | Geotechnical investigation an description of the seabed Foundations of Offshore-Constructions cCliff erosion Sea dikes Port structures Flood protection structures |
| Literature | EAK (2002): Empfehlungen für Küstenschutzbauwerke EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke Poulos H.G. (1988): Marine Geotechnics. Unwin Hyman, London Wagner P. (1990): Meerestechnik: Eine Einführung für Bauingenieure. Ernst & Sohn, Berlin |

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| Course L0549: Marine Geote | urse L0549: Marine Geotechnics | | |
|----------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Jürgen Grabe | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Course L1146: Steel Structur | Course L1146: Steel Structures in Foundation and Hydraulic Engineering | |
|------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Frank Feindt | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Design of a sheet pile wall, design of a combined sheet pile wall, piles, walings, connections, fatigue | |
| Literature | EAU 2012, EA-Pfähle, EAB | |

| Module M0858: Coast | tal Hydraulic Engineering I | | | |
|------------------------------------|--|--|--------------------|----------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Basics of Coastal Engineering (L08 | 07) | Lecture | 3 | 4 |
| Basics of Coastal Engineering (L14 | | Project-/problem-based Learni | ng 1 | 2 |
| Module Responsible | Prof. Peter Fröhle | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basics of hydraulic engineering, hydrolog | gy and hydromechanics | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students h | nave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are able to define and explain the basic concepts of coastal engineering and port engineering. They are able to app | | | |
| | the concepts to selected practical proble | ems of coastal engineering. Students can define and | d determine the b | pasics for design a |
| | dimensioning of coastal engineering con- | structions. | | |
| Skills | The students are capable to apply basic | design approaches to selected and pre-defined desig | ın tasks in coasta | l engineering. |
| Personal Competence | | | | |
| Social Competence | The students are able to deploy their ga | ained knowledge in applied problems such as the de | esign of coastal p | protection structure |
| | Additionaly, they will be able to work in t | team with engineers of other disciplines, for instance | designing of coa | stal breakwaters. |
| Autonomy | The students will be able to independent | tly extend their knowledge and applyit to new problem | ms. | |
| 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 | The duration of the examination is 2 h | nours. The examination includes tasks with respect | to the general u | understanding of t |
| scale | lecture contents and calculations tasks. | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal | Engineering: Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotech | nnical Engineering: Compulsory | | |
| | Civil Engineering: Specialisation Structur | ral Engineering: Elective Compulsory | | |
| | Environmental Engineering: Specialisation | on Environment and Climate: Elective Compulsory | | |
| | Environmental Engineering: Specialisation | on Water Quality and Water Engineering: Elective Cor | npulsory | |
| | International Management and Engineer | ing: Specialisation II. Civil Engineering: Elective Comp | oulsory | |
| | Water and Environmental Engineering: S | Specialisation Environment: Elective Compulsory | | |
| | Water and Environmental Engineering: S | Specialisation Water: Elective Compulsory | | |

| Image: market in the second | Course L0807: Basics of Coastal Engineering | | |
|---|---|--|--|
| CP 4 Workload in Hours Independent Study Time 78, Study Time in Lecture 42 Lecturer Prof. Peter Fröhle Language EN Cycle SoSe Content • Basics of planning and design • Water levels • Currents • Waves • Ice • Planning and Design in Coastal Engineering • Functional and constructional design • Determination of design parameters • Design-approaches • Filter • Rubble mound constructions • Piles • Vertical constructions | Тур | Lecture | |
| Workload in Hours Independent Study Time 78, Study Time in Lecture 42 Lecturer Prof. Peter Fröhle Language EN Cycle SoSe Content Basics of planning and design Water levels Currents Waves Ice Planning and Design in Coastal Engineering Functional and constructional design Determination of design parameters Design-approaches Filter Rubble mound constructions Piles Vertical constructions Piles Vertical constructions | Hrs/wk | 3 | |
| Lecturer Prof. Peter Fröhle Language EN Cycle SoSe Content • Basics of planning and design • Water levels • Currents • Waves • Ice • Planning and Design in Coastal Engineering • Functional and constructional design • Determination of design parameters • Design-approaches • Filter • Rubble mound constructions • Piles • Vertical constructions | CP | 4 | |
| Language EN Content Basics of planning and design Water levels Currents Waves Ice Planning and Design in Coastal Engineering Functional and constructional design Determination of design parameters Design-approaches Filter Rubble mound constructions Piles Vertical constructions Piles Vertical constructions Verti | Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | |
| Content SoSe Content Basics of planning and design Water levels Currents Waves Ice Planning and Design in Coastal Engineering Functional and constructional design Determination of design parameters Design-approaches Filter Rubble mound constructions Piles Vertical constructions Vertical constructions | Lecturer | Prof. Peter Fröhle | |
| Content Basics of planning and design Water levels Currents Waves Ice Planning and Design in Coastal Engineering Functional and constructional design Determination of design parameters Design-approaches Filter Rubble mound constructions Piles Vertical constructions | Language | EN | |
| Basics of planning and design Water levels Currents Waves Ice Planning and Design in Coastal Engineering Functional and constructional design Determination of design parameters Design-approaches Filter Rubble mound constructions Piles Vertical constructions | Cycle | SoSe | |
| Water levels Currents Waves Ice Planning and Design in Coastal Engineering Functional and constructional design Determination of design parameters Design-approaches Filter Rubble mound constructions Piles Vertical constructions | Content | | |
| Currents Waves Ice Planning and Design in Coastal Engineering Functional and constructional design Determination of design parameters Design-approaches Filter Rubble mound constructions Piles Vertical constructions | | | |
| Waves Ice Planning and Design in Coastal Engineering Functional and constructional design Determination of design parameters Design-approaches Filter Rubble mound constructions Piles Vertical constructions | | | |
| Ice Planning and Design in Coastal Engineering Functional and constructional design Determination of design parameters Design-approaches Filter Rubble mound constructions Piles Vertical constructions | | | |
| Functional and constructional design Determination of design parameters Design-approaches Filter Rubble mound constructions Piles Vertical constructions | | | |
| Functional and constructional design Determination of design parameters Design-approaches Filter Rubble mound constructions Piles Vertical constructions | | Planning and Design in Coastal Engineering | |
| Design-approaches Filter Rubble mound constructions Piles Vertical constructions | | | |
| Filter Rubble mound constructions Piles Vertical constructions | | Determination of design parameters | |
| Rubble mound constructions Piles Vertical constructions | | Design-approaches | |
| Piles Vertical constructions | | ■ Filter | |
| Vertical constructions | | | |
| | | | |
| Literature Coastal Engineering Manual, CEM | | Vertical constructions | |
| Literature Coastal Engineering Manual, CEM | | | |
| Literature Coastal Engineering Manual, CEM | | | |
| | Literature | Coastal Engineering Manual, CEM | |
| Vorlesungsumdruck | | Vorlesungsumdruck | |
| | | | |
| | | | |

| Course L1413: Basics of Coas | urse L1413: Basics of Coastal Engineering | | |
|------------------------------|---|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 1 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Prof. Peter Fröhle | | |
| Language | EN | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | |
|--|---|--|---------------------|--------------------|
| Courses | | | | |
| Title Smart Monitoring (L2762) | | Typ Integrated Lecture | Hrs/wk 2 | CP 2 |
| Smart Monitoring (L2762) Smart Monitoring (L2763) | | Recitation Section (small) | 2 | 4 |
| Module Responsible | Prof. Kay Smarsly | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge or interest in object-oriented modeli | og programming and sensor technolo | ogies are helpful | Interest in mor |
| Knowledge | | | | |
| - | skills of scientific working, are required. Basic knowledge | | | |
| | After taking part successfully, students have reached th | a following loorning regults | | |
| Professional Competence | After taking part successfully, students have reached the | le following learning results | | |
| | The students will become familiar with the principles | and practices of smart monitoring | The students wil | ll ha abla ta day |
| Kilowicuge | decentralized smart systems to be applied for cont | | | |
| | environment. In addition, the students will learn to des | | | |
| | analysis techniques, modern software design concepts, | | | |
| | also part of this module, which will be conducted thro | | | |
| | students will design smart monitoring systems that inte | egrate a number of "intelligent" sensors | s to be implemen | ited by the stude |
| | Specific focus will be put on the application of machin | ne learning techniques. The smart mo | nitoring systems | will be mounted |
| | real-world (built or natural) systems, such as bridges or | slopes, or on scaled lab structures for | validation purpo | ses. The outcom |
| | every group will be documented in a paper. All student | s of this module will "automatically" pa | articipate with the | eir smart monito |
| | system in the annual "Smart Monitoring" competition. The written papers and oral examinations form the final grades. The modu | | | |
| | will be taught in English. Limited enrollment. | | | |
| Skills | The students will gain insights into operating state-of-t | he-art smart sensor systems used for | monitoring a wi | de range of phys |
| SKIIS | processes relevant to engineering, such as environm | | | |
| | devising monitoring strategies of physical processes as part of group projects, tailored to their knowledge backgrounds, and | | | |
| | implement the strategies in smart wireless sensor nodes, using embedded computing and programming. Finally, the students w | | | |
| | be able to document the findings of their projects in she | ort reports. | | |
| Personal Competence | | | | |
| | The students will be able to work in groups, share part | s of the work for their projects, and de | evelop communic | ation skills, towa |
| | achieving the common project goals. | | | |
| | | | | |
| Autonomy | The students will be able to gain a solid basis on app | | ineering, as well | as on documen |
| | results, through their involvement in their monitoring g | roup projects. | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| | 10 pages of work with 15-minute oral presentation | | | |
| scale | Civil Family and Tarffier Flag | | | |
| Following Curricula | Civil Engineering: Specialisation Water and Traffic: Elec Civil Engineering: Specialisation Geotechnical Engineer | | | |
| ronowing curricula | Civil Engineering: Specialisation Coastal Engineering: E | • • • | | |
| | Civil Engineering: Specialisation Structural Engineering: | | | |
| | Computer Science: Specialisation II: Intelligence Engine | | | |
| | Environmental Engineering: Specialisation Energy and I | • • • | | |
| | Environmental Engineering: Specialisation Environment | | | |
| | Environmental Engineering: Specialisation Water Qualit | | pulsory | |
| | Mechatronics: Technical Complementary Course: Electi | | - | |
| | Mechatronics: Core Qualification: Elective Compulsory | | | |
| | Theoretical Mechanical Engineering: Specialisation Rob | otics and Computer Science: Elective C | Compulsory | |
| | Water and Environmental Engineering: Specialisation C | | | |
| | Water and Environmental Engineering: Specialisation E | nvironment: Elective Compulsory | | |
| | | The comparisony | | |

| Course L2762: Smart Monito | ring |
|----------------------------|--|
| Тур | Integrated Lecture |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Kay Smarsly |
| Language | EN |
| Cycle | SoSe |
| Content | In this course, principles of smart monitoring will be taught, focusing on modern concepts of data acquisition, data storage, and data analysis. Also, fundamentals of intelligent sensors and embedded computing will be illuminated. Autonomous software and decentralized data processing are further crucial parts of the course, including concepts of the Internet of Things, Industry 4.0 and cyber-physical systems. Furthermore, measuring principles, data acquisition systems, data management and data analysis algorithms will be discussed. Besides the theoretical background, numerous practical examples will be shown to demonstrate how smart monitoring may advantageously be used for assessing the condition of systems in the built or natural environment. |
| Literature | The course contents couples different fields, such as signal processing, sensing technologies, data analytics, environmental engineering, civil engineering, artificial intelligence, database systems, and many more. The basics will be taught in this course. However, specific literature that covers all these topics does not exist. Instead, literature will be referenced in the lectures, all of which are papers that are freely available online. |

| Course L2763: Smart Monito | ring |
|----------------------------|---|
| | Recitation Section (small) |
| Hrs/wk | |
| СР | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. Kay Smarsly |
| Language | EN |
| Cycle | SoSe |
| | The contents of the exercises are based on the lecture contents. In addition to the exercises, project work will be conducted throughout the semester, which will consume the majority of the workload. As part of the project work, students will design smart monitoring systems that will be tested in the laboratory or in the field. As mentioned in the module description, the students will participate in the "Smart Monitoring" competition, hosted annually by the Institute of Digital and Autonomous Construction. Students are encouraged to contribute their own ideas. The tools required to implement the smart monitoring systems will be taught in the group exercises as well as through external sources, such as video tutorials and literature. The course contents couples different fields, such as signal processing, sensing technologies, data analytics, environmental engineering, civil engineering, artificial intelligence, database systems, and many more. The basics will be taught in this course. |
| | However, specific literature that covers all these topics does not exist. Instead, literature will be referenced in the lectures, all of which are papers that are freely available online. |

| Courses | | | | | | |
|-----------------------------------|--|--|--|-------------------|--|--|
| Title | | Тур | Hrs/wk | СР | | |
| Offshore Geotechnical Engineering | (L0067) | Lecture | 1 | 1 | | |
| Hydro Power Use (L0013) | | Lecture | 1 | 1 | | |
| Wind Turbine Plants (L0011) | | Lecture | 2 | 3 | | |
| Wind Energy Use - Focus Offshore | (L0012) | Lecture | 1 | 1 | | |
| Module Responsible | Dr. Marvin Scherzinger | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Module: Technical Thermodynamics I, | | | | | |
| Knowledge | Module: Technical Thermodynamics II, | | | | | |
| | Module: Fundamentals of Fluid Mechanics | | | | | |
| Educational Objectives | After taking part successfully, students have reached | d the following learning results | | | | |
| Professional Competence | | | | | | |
| | By ending this module students can explain in detail knowledge of wind turbines with a particular focus of wind energy use offshore conditions and can critical comment these aspects in consideration of current developments. Furthermore, they are a to describe fundamentally the use of water power to generate electricity. The students reproduce and explain the basic proced in the implementation of renewable energy projects in countries outside Europe. Through active discussions of various topics within the seminar of the module, students improve their understanding and application of the theoretical background and are thus able to transfer what they have learned in practice. | | | | | |
| | | | | | | |
| Skills | Students are able to apply the acquired theoretical foundations on exemplary water or wind power systems and evaluate a assess technically the resulting relationships in the context of dimensioning and operation of these energy systems. They can compare critically the special procedure for the implementation of renewable energy projects in countries outside Europe with t in principle applied approach in Europe and can apply this procedure on exemplary theoretical projects. | | | | | |
| Personal Competence | | | | | | |
| Social Competence | Students can discuss scientific tasks subjet-specific | ly and multidisciplinary within a se | eminar. | | | |
| Autonomy | Students can independently exploit sources in the lecture and to acquire the particular knowledge about | | ecture material to clea | r the contents of | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture | 70 | | | | |
| Credit points | 6 | | | | | |
| Course achievement | None | | | | | |
| Examination | Written exam | | | | | |
| Examination duration and | 180 min | | | | | |
| scale | | | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineeri | ing: Elective Compulsory | | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engine | eering: Elective Compulsory | | | | |
| | Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory | | | | | |
| | International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory | | | | | |
| | International Management and Engineering: Speciali | isation II. Renewable Energy: Elect | ive Compulsory | | | |
| | Product Development, Materials and Production: Specialisation Product Development: Elective Compulsory | | | | | |
| | Product Development, Materials and Production: Specialisation Production: Elective Compulsory | | | | | |
| | Product Development, Materials and Production: Spe | ecialisation Production: Elective Co | Product Development, Materials and Production: Specialisation Materials: Elective Compulsory | | | |
| | | | npulsory | | | |
| | | ecialisation Materials: Elective Con | npulsory | | | |
| | Product Development, Materials and Production: Spe | ecialisation Materials: Elective Com , | | | | |
| | Product Development, Materials and Production: Spe Renewable Energies: Core Qualification: Compulsory | ecialisation Materials: Elective Con , inergy Systems: Elective Compulso | ory | | | |
| | Product Development, Materials and Production: Spe Renewable Energies: Core Qualification: Compulsory Theoretical Mechanical Engineering: Specialisation E | ecialisation Materials: Elective Con , inergy Systems: Elective Compuls rocess Engineering: Elective Comp | ory | | | |
| | Product Development, Materials and Production: Spe Renewable Energies: Core Qualification: Compulsory Theoretical Mechanical Engineering: Specialisation E Process Engineering: Specialisation Environmental P | ecialisation Materials: Elective Con , inergy Systems: Elective Compulso rocess Engineering: Elective Comp n Cities: Elective Compulsory | ory pulsory | | | |

| ourse L0067: Offshore Geot | echnical Engineering |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Jan Dührkop |
| Language | DE |
| Cycle | SoSe |
| Content | Overview and Introduction Offshore Geotechnics Introduction to Soil Mechanics Offshore soil investigation Focus on cyclical effects Geotechnical design of offshore foundations Monopiles Jackets Heavyweight foundations Geotechnical preliminary exploration for the use of lift boats and platforms |
| Literature | Randolph, M. and Gourvenec, S (2011): Offshore Geotechnical Engineering. Spon Press. Poulos H.G. (1988): Marine Geotechnics. Unwin Hyman, London BSH-Standard Baugrunderkundung für Offshore-Windenergieparks Lesny K. (2010): Foundations for Offshore Wind Turbines. VGE Verlag, Essen. EA-Pfähle (2012): Empfehlungen des Arbeitskreises Pfähle der DGGT. Ernst & Sohn, Berlin. |

| Course L0013: Hydro Power | Use |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Stefan Achleitner |
| Language | DE |
| Cycle | SoSe |
| Content | Introduction, importance of water power in the national and global context Physical basics: Bernoulli's equation, usable height of fall, hydrological measures, loss mechanisms, efficiencies Classification of Hydropower: Flow and Storage hydropower, low and high pressure systems Construction of hydroelectric power plants: description of the individual components and their technical system interaction Structural engineering components; representation of dams, weirs, dams, power houses, computer systems, etc. Energy Technical Components: Illustration of the different types of hydraulic machinery, generators and grid connection Hydropower and the Environment Examples from practice |
| Literature | Schröder, W.; Euler, G.; Schneider, K.: Grundlagen des Wasserbaus; Werner, Düsseldorf, 1999, 4. Auflage Quaschning, V.: Regenerative Energiesysteme: Technologie - Berechnung - Simulation; Carl Hanser, München, 2011, 7. Auflage Giesecke, J.; Heimerl, S.; Mosony, E.: Wasserkraftanlagen - Planung, Bau und Betrieb; Springer, Berlin, Heidelberg, 2009, 5. Auflage von König, F.; Jehle, C.: Bau von Wasserkraftanlagen - Praxisbezogene Planungsunterlagen; C. F. Müller, Heidelberg, 2005, 4. Auflage Strobl, T.; Zunic, F.: Wasserbau: Aktuelle Grundlagen - Neue Entwicklungen; Springer, Berlin, Heidelberg, 2006 |

| Course L0011: Wind Turbine | Plants |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Dr. Rudolf Zellermann |
| Language | DE |
| Cycle | SoSe |
| Content | Historical development Wind: origins, geographic and temporal distribution, locations Power coefficient, rotor thrust Aerodynamics of the rotor Operating performance Power limitation, partial load, pitch and stall control Plant selection, yield prediction, economy Excursion |
| Literature | Gasch, R., Windkraftanlagen, 4. Auflage, Teubner-Verlag, 2005 |

| Course L0012: Wind Energy | Use - Focus Offshore |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Martin Skiba |
| Language | DE |
| Cycle | SoSe |
| Content | Introduction, importance of offshore wind power generation, Specific requirements for offshore engineering Physical fundamentals for utilization of wind energy Design and operation of offshore wind turbines, presentation of different concepts of offshore wind turbines, representation of the individual system components and their system-technical relationships Foundation engineering, offshore site investigation, presentation of different concepts of offshore foundation structures, planning and fabrication of foundation structures Electrical infrastructure of an offshore wind farm, Inner Park cabling, offshore substation, grid connection Installation of offshore wind farms, installation techniques and auxiliary devices, construction logistics Development and planning of offshore wind farms Operation and optimization of offshore wind farms Day excursion |
| Literature | Gasch, R.; Twele, J.: Windkraftanlagen - Grundlagen, Entwurf, Planung und Betrieb; Vieweg + Teubner, Stuttgart, 2007, 7. Auflage Molly, J. P.: Windenergie - Theorie, Anwendung, Messung; C. F. Müller, Heidel-berg, 1997, 3. Auflage Hau, E.: Windkraftanlagen; Springer, Berlin, Heidelberg, 2008, 4.Auflage Heier, S.: Windkraftanlagen - Systemauslegung, Integration und Regelung; Vieweg + Teubner, Stuttgart, 2009, 5. Auflage Jarass, L.; Obermair, G.M.; Voigt, W.: Windenergie: Zuverlässige Integration in die Energieversorgung; Springer, Berlin, Heidelberg, 2009, 2. Auflage |

| Module M1845: Thin- | walled structures | | | | |
|-----------------------------------|--|--|-------------------|---------------------|--|
| Module M1645. Thin- | walled structures | | | | |
| Courses | | | | | |
| Title | | Тур | Hrs/wk | СР | |
| Thin-walled structures (L1199) | | Lecture | 2 | 3 | |
| Thin-walled structures (L3045) | | Recitation Section (large) | 2 | 3 | |
| Module Responsible | Prof. Bastian Oesterle | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | Structural Analysis I Structural Analysis II Finite Element Methods | | | | |
| Educational Objectives | After taking part successfully, students have reache | d the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | After successful completion of this module, the st | udents can express the basic aspects of | the load-carryin | g behaviour of thin | |
| | walled structures. | | | | |
| Skills | Skills After successful completion of this module, the students will be able to predict load-carrying behaviour of | | | | |
| 01110 | using appropriate analytical and coputational methods. | | | | |
| | | | | | |
| Personal Competence | | | | | |
| Social Competence | Students can | | | | |
| | participate in subject-specific and interdisciple | linary discussions, | | | |
| | defend their own work results in front of other | rs | | | |
| | promote the scientific development of colleage | gues | | | |
| | Furthermore, they can give and accept profes | - ssional constructive criticism | | | |
| | | | | | |
| Autonomy | Students are able to gain knowledge of the subject | ÷ , | | | |
| | they are able to structure the solution process for p | roblems in the area of modelling and analy | is of thin-walled | d structures. | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture | 2 56 | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and | 90 min | | | | |
| scale | | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Engineering | g: Elective Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engin | eering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Computational Eng | ineering: Compulsory | | | |
| | Civil Engineering: Specialisation Structural Engineer | ing: Elective Compulsory | | | |
| | Theoretical Mechanical Engineering: Specialisation | Simulation Technology: Elective Compulsor | ſУ | | |

| Тур | Lecture |
|-------------------|---|
| Hrs/wk | |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| | Prof. Bastian Oesterle |
| Language | DE |
| Cycle | SoSe |
| Content | Plates loaded in-plane |
| | Governing equations (equilibrium, kinematics, constitutive law) |
| | Differential equation |
| | Airy stress function |
| | Plane stress / plane strain |
| | Structural behaviour of plates loaded in-plane |
| | • finite elements for plates loaded in-plane, modelling apsects, interpretation and critical assessment of results |
| | Plates in bending |
| | Governing equations (equilibrium, kinematics, constitutive law) |
| | Differential equation |
| | Navier solution / Fourier series expansion |
| | Approximation procedures |
| | Circular and rectangular plates |
| | Structural behaviour of plates in bending |
| | finite elements for plates in bending, modelling apsects, interpretation and critical assessment of results |
| | Shells |
| | |
| | Phenomenona of the structural behaviour of shells |
| | Membrane and bending theory |
| | Equilibrium equations of shells of revolution |
| | Stress resultants and deformations of the spherical shell, the half spherical shell, and the cylindrical shell |
| | finite elements for shells |
| | Stability problems (overview) |
| | Plate buckling |
| | Shell buckling |
| | |
| I :toust | |
| Literature | Vorlesungsmanuskript |
| | • Basar, Y.: Krätzig, W.B. (1985): Mechanik der Flächentragwerke. Vieweg-Verlag, Braunschweig, Wiesbaden |
| | Girkmann, K. (1963): Flächentragwerke, Springer Verlag, Wien, 1963, unveränderter Nachdruck 1986 |
| | • Zienkiewicz, O.C. (1977): The Finite Element Method in Enginieering Science. McGraw-Hill, London |
| | |

| ourse L3045: Thin-walled structures | |
|-------------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Bastian Oesterle |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Courses | | | | |
|--------------------------------------|--|---|--------|----|
| Title | | Тур | Hrs/wk | СР |
| oining of Polymer-Metal Lightweig | ht Structures (L0500) | Lecture | 2 | 2 |
| oining of Polymer-Metal Lightweig | | Practical Course | 1 | 1 |
| Metallic Light-weight Materials (L16 | 560) | Lecture | 2 | 3 |
| Module Responsible | Prof. Marcus Rutner | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students h | nave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | | | | |
| Skills | | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| , Autonomy | | | | |
| Workload in Hours | Independent Study Time 110, Study Tim | e in Lecture 70 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Oral exam | | | |
| Examination duration and | 45 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structur | ral Engineering: Elective Compulsory | | |
| Following Curricula | Materials Science and Engineering: Spec | ialisation Engineering Materials: Elective Compu | lsory | |
| - | Materials Science: Specialisation Engine | ering Materials: Elective Compulsory | | |
| | Theoretical Mechanical Engineering: Spe | ecialisation Materials Science: Elective Compulso | n/ | |

| | ymer-Metal Lightweight Structures |
|-------------------|--|
| | Lecture |
| Hrs/wk | |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Marcus Rutner |
| Language | EN |
| Cycle | WiSe |
| Content | Contents: |
| | The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-meta lightweight structures used in engineering applications. A general understanding of the principles of the consolidated and ner technologies and its main fields of applications is to be accomplished through theoretical and practical lectures. |
| | Theoretical Lectures: |
| | Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics Mechanical Fastening of Polymer-Metal Hybrid Structures Adhesive Bonding of Polymer-Metal Hybrid Structures Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures Laboratory Exercises: Joining Processes: Introduction to state-of-the-art joining technologies Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints Course Outcomes: After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer metal lightweight structures as well as their application fields. |
| Literature | S. T. Amancio-Filho, LA. Blaga, Joining of Polymer-Metal Hybrid Structures, Wiley, 2018 J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers D.A. Grewell, A. Benatar, J.B. Park, Plastics and Composites Welding Handbook D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limited J. Friedrich, Metal-Polymer Systems: Interface Design and Chemical Bonding, Wiley, 2017 |

| Course L0501: Joining of Poly | urse L0501: Joining of Polymer-Metal Lightweight Structures | |
|-------------------------------|---|--|
| Тур | Practical Course | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Marcus Rutner | |
| Language | EN | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| - | -weight Materials |
|--------------|---|
| | Lecture |
| Hrs/wk CP | |
| | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Dr. Domonkos Tolnai |
| Language | |
| Cycle | Wise Lightweight construction |
| content | - Structural lightweight construction |
| | - Material lightweight construction |
| | - Choice criteria for metallic lightweight construction materials |
| | Steel as lightweight construction materials |
| | - Introduction to the fundamentals of steels |
| | - Modern steels for the lightweight construction |
| | - Fine grain steels |
| | - High-strength low-alloyed steels |
| | - Multi-phase steels (dual phase, TRIP) |
| | - Weldability |
| | - Applications |
| | |
| | Aluminium alloys: |
| | Introduction to the fundamentals of aluminium materials |
| | Alloy systems |
| | Non age-hardenable Al alloys: Processing and microstructure, mechanical qualities an applications |
| | Age-hardenable AI alloys: Processing and microstructure, mechanical qualities and applications |
| | Magnesium alloys |
| | Introduction to the fundamental of magnesium materials |
| | Alloy systems |
| | Magnesium casting alloys, processing, microstructure and qualities |
| | Magnesium wrought alloys, processing, microstructure and qualities |
| | Examples of applications |
| | Titanium alloys |
| | Introduction to the fundamental of the titanium materials |
| | Alloy systems |
| | Processing, microstructure and properties |
| | |

| | Exercises and excursions |
|------------|--|
| Literature | George Krauss, Steels: Processing, Structure, and Performance, 978-0-87170-817-5, 2006, 613 S. |
| | Hans Berns, Werner Theisen, Ferrous Materials: Steel and Cast Iron, 2008. http://dx.doi.org/10.1007/978-3-540-71848-2 |
| | C. W. Wegst, Stahlschlüssel = Key to steel = La Clé des aciers = Chiave dell'acciaio = Liave del acero ISBN/ISSN: 3922599095 |
| | Bruno C., De Cooman / John G. Speer: Fundamentals of Steel Product Physical Metallurgy, 2011, 642 S. |
| | Harry Chandler, Steel Metallurgy for the Non-Metallurgist 0-87170-652-0 , 2006, 84 S. |
| | Catrin Kammer, Aluminium Taschenbuch 1, Grundlagen und Werkstoffe, Beuth, 16. Auflage 2009. 784 S., ISBN 978-3-410-22028-2 |
| | Günter Drossel, Susanne Friedrich, Catrin Kammer und Wolfgang Lehnert, Aluminium Taschenbuch 2, Umformung von Aluminium-Werkstoffen, Gießen von Aluminiumteilen, Oberflächenbehandlung von Aluminium, Recycling und Ökologie, Beuth, 16. Auflage 2009. 768 S., ISBN 978-3-410-22029-9 |
| | Catrin Kammer, Aluminium Taschenbuch 3, Weiterverarbeitung und Anwendung, Beuith,17. Auflage 2014. 892 S., ISBN 978-3-410-22311-5 |
| | G. Lütjering, J.C. Williams: Titanium, 2nd ed., Springer, Berlin, Heidelberg, 2007, ISBN 978-3-540- 71397 |
| | Magnesium - Alloys and Technologies, K. U. Kainer (Hrsg.), Wiley-VCH, Weinheim 2003, ISBN 3- 527-30570-x |
| | Mihriban O. Pekguleryuz, Karl U. Kainer and Ali Kaya "Fundamentals of Magnesium Alloy Metallurgy", Woodhead Publishing Ltd, 2013,ISBN 10: 0857090887 |
| | |
| | |
| | |

| Courses | | | | |
|-----------------------------------|---|--|-------------------------|---------------------|
| Title | | Тур | Hrs/wk | СР |
| Water Protection and Wastewater I | Aanagement (L0226) | Lecture | 3 | 3 |
| Water Protection and Wastewater I | lanagement (L2008) | Project Seminar | 3 | 3 |
| Module Responsible | Prof. Ralf Otterpohl | | | |
| Admission Requirements | None | | | |
| Recommended Previous | • Pasis knowledge in water management | | | |
| Knowledge | Basic knowledge in water management; Good knowledge in urban drainage; | | | |
| | Good knowledge in dibari dramage, Good knowledge of wastewater treatment | techniques | | |
| | Good knowledge of pollutants (e.g. COD, E | | | |
| | | | | |
| Educational Objectives | After taking part successfully, students have read | hed the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students can describe the basic principles of | | | |
| | They can explain limnological processes, subst | , | 3 | |
| | problems related to water protection, such as e | | atment with a special | focus on innovati |
| | solutions, remediation measures as well as conce | ptual approaches. | | |
| Skills | Students can accurately assess current problem | s and situations in a country-specific o | r local context. They o | can suggest concre |
| | actions to contribute to the planning of tomor | row's urban water cycle. Furthermore, | they can suggest a | ppropriate technica |
| | administrative and legislative solutions to solve t | hese problems. | | |
| | | | | |
| | | | | |
| | | | | |
| D | | | | |
| Personal Competence | - | | | |
| Social Competence | The students can work together in international g | roups. | | |
| | | | | |
| | | | | |
| | | | | |
| Autonomy | Students are able to organize their work flow to | prepare presentations and discussions | . They can acquire ap | propriate knowled |
| | by making enquiries independently. | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lectu | re 84 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Presentation | | | |
| | Term paper plus presentation | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engine | eering: Elective Compulsory | | |
| Following Curricula | | • • • • | | |
| . eenning curriculu | Civil Engineering: Specialisation Coastal Engineer | | | |
| | Civil Engineering: Specialisation Water and Traffi | | | |
| | Environmental Engineering: Specialisation Water | | e Compulsory | |
| | International Management and Engineering: Spec | | | |
| | Water and Environmental Engineering: Specialisa | • • | . , | |
| | Water and Environmental Engineering: Specialisa | | | |
| | Water and Environmental Engineering: Specialisa | tion Environment: Compulsory | | |

| Course L0226: Water Protect | tion and Wastewater Management |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Prof. Ralf Otterpohl |
| Language | EN |
| Cycle | WiSe |
| Content | The lecture focusses on: Regulatory Framework (e.g. WFD) Main instruments for the water management and protection In depth knowledge of relevant measures of water pollution control Urban drainage, treatment options in different regions on the world Rainwater management, improved management of heavy rainfalls, downpours, rainwater harvesting, rainwater infiltration Case Studies and Field Trips |
| Literature | The literature listed below is available in the library of the TUHH. Water and wastewater technology Hammer, M. J. 1., & . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International. Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011) New York, NY: McGraw-Hill. Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ. |

| Course L2008: Water Protection and Wastewater Management | |
|--|---|
| Тур | Project Seminar |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Prof. Ralf Otterpohl |
| Language | EN |
| Cycle | WiSe |
| Content | |
| Literature | |

| Courses | | | | |
|--|--|--|------------------|---------------------|
| Title | | Тур | Hrs/wk | СР |
| Examination of Materials, Structura | - | Lecture | 3 | 4 |
| Examination of Materials, Structura | al Condition and Damages (L0261) | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Frank Schmidt-Döhl | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge about building materials or ma | aterial science, for example by the mod | ule Building Ma | terials and Buildir |
| Knowledge | Chemistry. | | | |
| Educational Objectives | After taking part successfully, students have reach | ed the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are able to describe the rules for trading, use and marking of construction products in Germany. They know whic methods for the testing of building material properties are usable and know the limitations and characterics of the most important testing methods. | | | |
| Skills | The students are able to responsibly discover the rules for trading and using of building products in Germany. They are able to chose suitable methods for the testing and inspection of construction products, the examination of damages ar the examination of the structural conditions of buildings. They are able to conclude from symptons to the cause of damages. The are able to describe an examination in form of a test report or expert opinion. | | | |
| Personal Competence Social Competence | The students can describe the different roles of m framework of material testing. They can describe th | ÷ , | - | on bodies within tł |
| Autonomy | | | edge of a very e | xtensive field. |
| Workload in Hours | Independent Study Time 124, Study Time in Lectur | e 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Enginee | ring: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engin | neering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Coastal Engineerin | g: Elective Compulsory | | |
| | Civil Engineering: Specialisation Water and Traffic: | Elective Compulsory | | |
| | International Management and Engineering: Specia | lisation II. Civil Engineering: Elective Compu | ulsory | |
| | Materials Science and Engineering: Specialisation E | ngineering Materials: Elective Compulsory | | |
| | Materials Science: Specialisation Engineering Mate | rials: Elective Compulsory | | |

| Course L0260: Examination of | Course L0260: Examination of Materials, Structural Condition and Damages | | |
|------------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 3 | | |
| СР | 4 | | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | | |
| Lecturer | Prof. Frank Schmidt-Döhl | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Materials testing and marking process of construction products, testing methods for building materials and structures, testi | | |
| | reports and expert opinions, describing the condition of a structure, from symptons to the cause of damages | | |
| Literature | Frank Schmidt-Döhl: Materialprüfung im Bauwesen. Fraunhofer irb-Verlag, Stuttgart, 2013. | | |

| Course L0261: Examination of | ourse L0261: Examination of Materials, Structural Condition and Damages | |
|------------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Frank Schmidt-Döhl | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|-------------------------------------|--|--|--------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Nonlinear Structural Analysis (L027 | 7) | Lecture | 3 | 4 |
| Nonlinear Structural Analysis (L027 | 9) | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Alexander Düster | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Knowledge of partial differential equations is | s recommended. | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have | e reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to | | | |
| | + give an overview of the different nonlinea | r phenomena in structural mechanics. | | |
| | + explain the mechanical background of nor | | | |
| | | al analysis, to identify them in a given situation | and to explain the | eir mathematical a |
| | mechanical background. | | | |
| Skills | Students are able to | | | |
| | + model nonlinear structural problems. | | | |
| | + select for a given nonlinear structural pro | blem a suitable computational procedure. | | |
| | + apply finite element procedures for nonlin | near structural analysis. | | |
| | + critically verify and judge results of nonlin | ear finite elements. | | |
| | + to transfer their knowledge of nonlinear s | olution procedures to new problems. | | |
| Personal Competence | | | | |
| | Students are able to | | | |
| Social competence | + solve problems in heterogeneous groups. | | | |
| | + present and discuss their results in front of | of others | | |
| | + give and accept professional constructive | | | |
| | 5 | | | |
| | | | | |
| Autonomy | Students are able to | | | |
| | + assess their knowledge by means of exer | | | |
| | + acquaint themselves with the necessary k + to transform the acquired knowledge to s | | | |
| | | | | |
| | | | | |
| Workload in Hours | Independent Study Time 124, Study Time in | Locture 56 | | |
| Credit points | | Lecture 50 | | |
| Course achievement | | | | |
| | | | | |
| Examination | | | | |
| Examination duration and scale | 120 min | | | |
| | Civil Englisher in a consistentian Characterial | The second s | | |
| Following Curricula | Civil Engineering: Specialisation Structural E Civil Engineering: Specialisation Computation | 5 5 1 5 | | |
| r onowing curricula | | Specialisation II. Civil Engineering: Elective Com | pulsory | |
| | Materials Science: Specialisation Modeling: | | paisory | |
| | Mechatronics: Technical Complementary Co | | | |
| | Mechatronics: Core Qualification: Elective Co | | | |
| | | tion: Core Qualification: Elective Compulsory | | |
| | Naval Architecture and Ocean Engineering: | | | |
| | Ship and Offshore Technology: Core Qualific | | | |
| | Theoretical Mechanical Engineering: Special | insting Circulation Taskasland, Elective Compute | | |

| Course L0277: Nonlinear Str | uctural Analysis |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Alexander Düster |
| Language | EN |
| Cycle | WiSe |
| Content | 1. Introduction |
| | 2. Nonlinear phenomena |
| | 3. Mathematical preliminaries |
| | 4. Basic equations of continuum mechanics |
| | 5. Spatial discretization with finite elements |
| | 6. Solution of nonlinear systems of equations |
| | 7. Solution of elastoplastic problems |
| | 8. Stability problems |
| | 9. Contact problems |
| Literature | [1] Alexander Düster, Nonlinear Structrual Analysis, Lecture Notes, Technische Universität Hamburg-Harburg, 2014. |
| | [2] Peter Wriggers, Nonlinear Finite Element Methods, Springer 2008. |
| | [3] Peter Wriggers, Nichtlineare Finite-Elemente-Methoden, Springer 2001. |
| | [4] Javier Bonet and Richard D. Wood, Nonlinear Continuum Mechanics for Finite Element Analysis, Cambridge University Press, |
| | 2008. |

| Course L0279: Nonlinear Structural Analysis | |
|---|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Alexander Düster |
| Language | EN |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Courses | | | | |
|------------------------------------|--|---|----------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Chemistry of Drinking Water Treatr | nent (L0311) | Lecture | 2 | 1 |
| Chemistry of Drinking Water Treatr | nent (L0312) | Recitation Section (large) | 1 | 2 |
| Water Resource Management (L04) | 02) | Lecture | 2 | 2 |
| Water Resource Management (L04) | 3) | Recitation Section (small) | 1 | 1 |
| Module Responsible | Prof. Mathias Ernst | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Knowledge of water management and th | e key processes involved in water treatment. | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students h | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students will be able to outline key area | as of conflict in water management, as well as t | heir mutual depen | dence for sustaina |
| | water supply. They will understand rele | vant economic, environmental and social factors | s. Students will be | able to explain a |
| | outline the organisational structures of w | ater companies. They will be able to explain the a | available water trea | atment processes |
| | the scope of their application. | | | |
| CL 111- | | | | |
| SKIIIS | | plex problems in drinking water production a | | - |
| | | hey will be able to assess the evaluation methods | | |
| | | ons for selected treatment processes and apply | generally accepted | d technical rules |
| | standards to these processes. | | | |
| Personal Competence | | | | |
| Social Competence | Working in a diverse group of specialists | , students will be able to develop and document | complex solutions | for the managem |
| , | | will be able to take an appropriate professional | | ÷ |
| | | nt solutions in teams of diverse experts and prese | | |
| | | | | |
| Autonomy | Students will be in a position to work on a | a subject independently and present on this subje | ct. | |
| Workload in Hours | Independent Study Time 96, Study Time | in Lecture 84 | | |
| Credit points | | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 60 min (chemistry) + presentation | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structure | al Engineering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotech | nical Engineering: Elective Compulsory | | |
| - | Civil Engineering: Specialisation Water ar | | | |
| | Civil Engineering: Specialisation Coastal | | | |
| | | echnical Complementary Course: Elective Compuls | sory | |
| | | ng: Specialisation II. Energy and Environmental Er | | Compulsory |
| | • • | onmental Process Engineering: Elective Compulso | | |
| | Process Engineering: Specialisation Proce | • • • | - | |
| | | | | |
| | Water and Environmental Endineering. S | pecialisation water: Compulsorv | | |
| | Water and Environmental Engineering: S Water and Environmental Engineering: S | pecialisation water: compulsory pecialisation Environment: Elective Compulsory | | |

| Course L0311: Chemistry of | Drinking Water Treatment |
|----------------------------|---|
| | Lecture |
| Hrs/wk | |
| CP | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Dr. Klaus Johannsen |
| Language | DE |
| Cycle | WiSe |
| Content | The topic of this course is water chemistry with respect to drinking water treatment and water distribution |
| | Major topics are solubility of gases, carbonic acid system and calcium carbonate, blending, softening, redox processes, materials and legal requirements on drinking water treatment. Focus is put on generally accepted rules of technology (DVGW- and DIN- standards). Special emphasis is put on calculations using realistic analysis data (e.g. calculation of pH or calcium carbonate dissolution potential) in exercises. Students can get a feedback and gain extra points for exam by solving problems for homework. Knowledge of drinking water treatment processes is vital for this lecture. Therefore the most important processes are explained coordinated with the course " Water resources management" in the beginning of the semester. |
| Literature | MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John Wiley & Sons, Hoboken, 2005. Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley & Sons, New York, 1996. DVGW (Hrsg.): Wasseraufbereitung - Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004. Jensen, J. N.: A Problem Solving Approach to Aquatic Chemistry. John Wiley & Sons, Inc., New York, 2003. |

| Course L0312: Chemistry of Drinking Water Treatment | |
|---|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| CP | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Dr. Klaus Johannsen |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L0402: Water Resour | rce Management |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Mathias Ernst |
| Language | DE |
| Cycle | WiSe |
| Content | The lecture provides comprehensive knowledge on interaction of water ressource management and drinking water supply. Content |
| | overview: Current situation of global water resources User and Stakeholder conflicts Wasserressourcenmanagement in urbane Gebieten Rechtliche Aspekte, Organisationsformen Trinkwasserversorgungsunternehmen. Ökobilanzierung, Benchmarking in der Wasserversorgung |
| Literature | Aktuelle UN World Water Development Reports Branchenbild der deutschen Wasserwirtschaft, VKU (2011) Aktuelle Artikel wissenschaftlicher Zeitschriften Ppt der Vorlesung |

| Course L0403: Water Resour | ourse L0403: Water Resource Management | | |
|----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Mathias Ernst | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | |
|---|---|------------|---------------|-------------------|
| | - | | 11 | |
| Title Integrated Transportation Planning | y (L1068) Typ Project-/problem-based | Learning | Hrs/wk 4 | CP 6 |
| Module Responsible | | Learning | - | 0 |
| Admission Requirements | | | | |
| Recommended Previous | | anchort B | lanning and T | roffic Engineerin |
| Keconniended Previous | | ansport P | lanning and 1 | ranic Engineerin |
| | After taking part successfully, students have reached the following learning results | | | |
| Professional Competence | | | | |
| | Students are able to: | | | |
| ranomedge | | | | |
| | describe interdependencies between land-use/location choice and transportation | | | |
| | explain and evaluate the social, ecological and economic effects of transport and | | | res. |
| | relate current issues in the area of integrated transport planning and formulate a | in opinion | on them. | |
| Skills | Students are able to: | | | |
| | | | | |
| | • quantify important parameters, which influence travel demand or are influenced | | | |
| | comprehensively examine a pre-defined or self-selected topic from a transporta results in accordance with scientific conventions. | tion studi | es perspectiv | e and document t |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Students are able to: | | | |
| | provide feedback on topical contents and their teaching. | | | |
| | constructively handle feedback on their own work. | | | |
| | produce results in group work and document these. | | | |
| Autonomy | Students are able to: | | | |
| | assess potential consequences of their future professional activities | | | |
| | independently plan working on a pre-defined project topic, acquire the necessary | v knowled | lae and use a | opropriate means |
| | its execution. | y knowiec | ige and use a | |
| | | | | |
| | | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | written assignment with presentation during the semester | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Elective Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Water and Traffic: Compulsory | | | |
| | Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective | Compuls | ory | |
| | Water and Environmental Engineering: Specialisation Cities: Compulsory | | | |

| Course L1068: Integrated Tr | ansportation Planning |
|-----------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| СР | 6 |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Lecturer | Prof. Carsten Gertz, Dr. Philine Gaffron, Jacqueline Bianca Maaß |
| Language | DE |
| Cycle | WiSe |
| | The course will provide students with an understanding of interdependencies between land-use and transportation. Specific topics include a.o.: interactions between transport and the environment and consequent limitations characteristics of integrated planning complex planning processes interdependencies of location choice and mobility behaviour transport and land-use policies project on current issues in transportation studies |
| Literature | Kutter, Eckhard (2019) Stadtstruktur und Erreichbarkeit in der postfossilen Zukunft. Erich Schmidt Verlag. Berlin. Gies, Huber u. a. (Hrsg.) (93. Ergänzung 2022) Handbuch der kommunalen Verkehrsplanung. Herbert Wichmann Verlag. Berlin, Offenbach. (Loseblattsammlung mit kontinuierlichen Ergänzungen) |

| Courses | | | | | |
|-------------------------------------|---|------------------------------|---|--------|----|
| Гitle | | | Тур | Hrs/wk | СР |
| Applied Tunnel Constructions (L24 |)7) | | Lecture | 2 | 3 |
| ntroduction to tunnel construction | (L0707) | | Lecture | 1 | 2 |
| Introduction to tunnel construction | (L1811) | | Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof. Jürgen Grabe | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Modules from Bachelor | studies Civil and environr | nental engineering: | | |
| Knowledge | Geotechnics I-II | | | | |
| Educational Objectives | After taking part succes | ssfully, students have read | ched the following learning results | | |
| Professional Competence | | | | | |
| Knowledge | Knowledge of different tunnel construction types as well as special methods and techniques of subsoil construction. | | | | |
| Skills | Basic knowledge of tun | nnel design as well as prac | tical skills in structural tunnel analysis. | | |
| Personal Competence | | | | | |
| Social Competence | Capacity for teamwork concerning project management and design of tunnels. | | | | |
| Autonomy | Promotion of independent and creative work flow in the framework of a design exercise. | | | | |
| Workload in Hours | Independent Study Tim | ne 124, Study Time in Lect | ure 56 | | |
| Credit points | 6 | | | | |
| Course achievement | Compulsory Bonus | Form | Description | | |
| | No 5 % | Excercises | | | |
| Examination | Written exam | | | | |
| Examination duration and | 120 minutes | | | | |
| scale | | | | | |
| Assignment for the | Civil Engineering: Spec | ialisation Structural Engine | eering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Spec | ialisation Geotechnical En | gineering: Compulsory | | |
| | Civil Engineering: Speci | ialisation Coastal Enginee | ring: Compulsory | | |
| | Civil Engineering: Speci | ialisation Water and Traffi | c: Elective Compulsory | | |
| | Civil Engineering: Spec | ialisation Computational E | ngineering: Elective Compulsory | | |
| | | | | | |

| Course L2407: Applied Tunnel Constructions | |
|--|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Jürgen Grabe, Tim Babendererde |
| Language | DE |
| Cycle | WiSe |
| Content | |
| Literature | |

| Course L0707: Introduction t | o tunnel construction | | |
|------------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Dr. Julian Bubel | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Definitions Historical development in tunneling Geology for tunneling Hard rock tunneling (construction composite and machines) Tunnelung in temporarly stable soil with conventional construction methods Tunneling in soft soils (form of supports, shield types, compressed air application) Pipe jacking Tunnel Lining, tunnel supporting structures Calculation approaches for supporting structures in shield-driven tunnels Surveying for tunneling Safety requirements Construction Contract Literature and sources | | |
| Literature | Vorlesung/Übung s. www.tu-harburg.de/gbt | | |

| Course L1811: Introduction to tunnel construction | |
|---|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Julian Bubel |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

Module M0969: Selected Topics in Civil Engineering

| Courses | | | | |
|--|---|--|---------------------|-----------------|
| Title | | Тур | Hrs/wk | СР |
| Design of Composite Bridges (L3092) | | Integrated Lecture | 2 | 3 |
| Analysis of Offshore Structures (L1867) | | Lecture | 1 | 1 |
| Energy Geotechnics (L3227) | | Lecture | 3 | 3 |
| Solid Matter Process Technology for Biomass (L0052) | | Lecture | 2 | 3 |
| Forum I - Geotechnics and Construction Management (L1634) | | Seminar | 1 | 1 |
| Forum II - Geotechnics and Construction Management (L1635) | | Seminar | 1 | 1 |
| Timber Structures (L1151) | | Seminar | 2 | 2 |
| Innovative Timber Construction (L2666) | | Lecture | 2 | 4 |
| Glass Structures (L1152) | | Lecture | 2 | 2 |
| Glass Structures (L1447) | | Recitation Section (large) | 1 | 1 |
| Sustainable landfill design and operation (L3270) | | Integrated Lecture | 3 | 3 |
| Special Topics in Steel Design (L3091) | | Integrated Lecture | 2 | 3 |
| Special topics of civil engineering 1CP (L2378) | | | 1 | 1 |
| Special topics of civil engineering 2 LP (L2379) | | | 2 | 2 |
| Special topics of civil engineering 3 LP (L2380) | | | 3 | 3 |
| Structural Design (L2789) | | Seminar | 2 | 2 |
| Module Responsible | Prof. Frank Schmidt-Döhl | | | |
| Admission Requirements | None | | | |
| Recommended Previous | none | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reache | d the following learning results | | |
| Professional Competence | | | | |
| Knowledge | | | | |
| | Students are able to find their way through see | elected special areas within civil and struc | tural engineering |]. |
| | Students are able to explain basic models and | d procedures in selected special areas of | civil and structura | al engineering. |
| | Students are able to interrelate scientific and | technical knowledge. | | |
| Skills | Students are able to apply basic methods in selected areas of civil and structural engineering. | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| | | | | |
| Autonomy | Students can chose independently, in which fields they want to deepen their knowledge and skills through the election of courses. | | | |
| Workload in Hours | Depends on choice of courses | | | |
| Credit points | 6 | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Elective Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engine | eering: Elective Compulsory | | |
| _ | Civil Engineering: Specialisation Coastal Engineering | g: Elective Compulsory | | |
| | Civil Engineering: Specialisation Water and Traffic: E | | | |
| | Civil Engineering: Specialisation Computational Engi | | | |
| | eren Engineering. Specialisation compatational Engi | incernig. Elective compulsory | | |

| Course L3092: Design of Composite Bridges | | |
|---|---|--|
| Тур | Integrated Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Examination Form | Klausur | |
| Examination duration and | 90 min | |
| scale | | |
| Lecturer | Prof. Marcus Rutner | |
| Language | DE | |
| Cycle | SoSe | |
| Content | | |
| Literature | | |

Module Manual M.Sc. "Civil Engineering"

| Тур | Lecture |
|--------------------------|---|
| | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | Mündliche Prüfung |
| Examination duration and | 30 min |
| scale | |
| | Dr. Said Fawad Mohammadi |
| Language Cycle | |
| | Topic 1: Types of Offshore Structures, Fixed and floating structures for Oil & Gas and Offshore Wind industry |
| | Topic 2: Wave Forces, Morisons equation |
| | Topic 3: Irregular Seastates, Power spectrum and application of FFT |
| | Topic 4: Additional Environmental Forces, wind spectra, current forces |
| | Topic 5: Linear-Time-Invariant Systems, response of an LTI-system in frequency domain |
| | Topic 6: Tubular Welded Connections, stress concentration factors, weld geometry |
| | Topic 7: Introduction to Fracture Mechanics, criteria for fracture initiation and crack growth |
| | Topic 8: Time and Frequency Domain Fatigue Analyses, rainflow counting, application of LTI-systems for frequency domain fatigue |
| | Topic 9: Offshore Installation and Exam, installation of structures, pile driving, pipe laying techniques |
| Literature | Chakrabarti, Handbook of Offshore Engineering, 2005 |
| | Sarpkaya, Wave Forces on Offshore Structures, 2010 |
| | Faltinsen, Sea Loads on Ships and Offshore Structures, 1998 |
| | Sorensen, Basic Coastal Engineering, 2006 |
| | Dowling, Mechanical Behavior of Materials, 2007 |
| | Haibach, Betriebsfestigkeit, 2006 |
| | Marshall, Design of Welded Tubular Connections, 1992 |
| | Newland, Random vibrations, spectral and wavelet analysis, 1993 |
| | |

| Course L3227: Energy Geotechnics | |
|----------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Examination Form | Schriftliche Ausarbeitung (laut FPrO) |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt |
| scale | |
| Lecturer | Pauline Kaminski |
| Language | DE/EN |
| Cycle | WiSe |
| Content | Energy geotechnics is a young field in geotechnical engineering with the aim of developing sustainable geotechnical solutions for future-oriented issues relating to the production, transport, operation, decommissioning, and waste utilisation of various energy sources. Examples of possible fields of activity in energy geotechnics include geothermal energy and thermally activated foundation components, foundations for onshore and offshore wind turbines, the decommissioning of mining facilities and the handling of waste products from fossil fuels such as tailings and the geological storage of CO2. Relevant soil mechanical processes in these applications include the thermo-hydro-mechanically coupled behaviour of soils, multiphase flow in porous media and partially saturated soils. The lecture gives an overview of various aspects of energy geotechnics and provides in-depth knowledge of the associated soil mechanical processes. In addition, CO2-scarce geotechnical applications are discussed and emission estimates as well as the optimisation of geotechnical structures according to sustainability aspects are addressed. |
| Literature | |

| Course L0052: Solid Matter F | Process Technology for Biomass |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Examination Form | Klausur |
| Examination duration and | 60 min |
| scale | |
| Lecturer | Prof. Werner Sitzmann |
| Language | DE |
| Cycle | SoSe |
| Content | The industrial application of unit operations as part of process engineering is explained by actual examples of solid biomass |
| | processes. Size reduction, transportation and dosing, drying and agglomeration of renewable resources are described as important |
| | unit operations when producing solid fuels and bioethanol, producing and refining edible oils, when making Btl - and WPC - |
| | products. Aspects of explosion protection and plant design complete the lecture. |
| Literature | Kaltschmitt M., Hartmann H. (Hrsg.): Energie aus Bioamsse, Springer Verlag, 2001, ISBN 3-540-64853-4 |
| | Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz, Schriftenreihe Nachwachsende Rohstoffe, |
| | Fachagentur Nachwachsende Rohstoffe e.V. www.nachwachsende-rohstoffe.de |
| | Bockisch M.: Nahrungsfette und -öle, Ulmer Verlag, 1993, ISBN 380000158175 |
| | |

| Course L1634: Forum I - Geotechnics and Construction Management | |
|---|---|
| Тур | Seminar |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | Mündliche Prüfung |
| Examination duration and | 30 min |
| scale | |
| Lecturer | Prof. Jürgen Grabe |
| Language | DE |
| Cycle | WiSe |
| Content | Lectures about projects and issues with practical and scientific relevance. |
| Literature | |

| Course L1635: Forum II - Geo | Course L1635: Forum II - Geotechnics and Construction Management | |
|------------------------------|---|--|
| Тур | Seminar | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Examination Form | Mündliche Prüfung | |
| Examination duration and | 30 min | |
| scale | | |
| Lecturer | Prof. Jürgen Grabe | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Lectures about projects and issues with practical and scientific relevance. | |
| Literature | | |

| Course L1151: Timber Struct | Course L1151: Timber Structures | |
|-----------------------------|---|--|
| Тур | Seminar | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Examination Form | Referat | |
| Examination duration and | 90 min | |
| scale | | |
| Lecturer | Prof. Torsten Faber | |
| Language | DE | |
| Cycle | WiSe | |
| Content | | |
| Literature | | |

| Course L2666: Innovative Timber Construction | |
|--|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Examination Form | Schriftliche Ausarbeitung |
| Examination duration and | 45 Minuten |
| scale | |
| Lecturer | Dr. Andreas Meisel |
| Language | DE |
| Cycle | WiSe |
| Content | |
| Literature | - Blass, J.: "Ingenieurholzbau" |
| | - Schickhofer, G.: "BSPhandbuch: Holz-Massivbauweise in Brettsperrholz" |
| | - Informationsdienst Holz: div. Merkblätter und Broschüren |
| | - Wallner-Novak M.: Brettsperrholz Bemessung, Band 1 und 2 |
| | - Gerner M.: "Fachwerk: Entwicklung, Instandsetzung, Neubau" |
| | - Meisel, A.: "Historische Dachwerke: Beurteilung, realitätsnahe statische Analyse und Instandsetzung" |
| | - Kempe K.: "Dokumentation Holzschädlinge" |
| | - Huckfeldt T.: "Hausfäule- und Bauholzpilze" |

| Course L1152: Glass Structures | |
|--------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Examination Form | Mündliche Prüfung |
| Examination duration and | |
| scale | |
| Lecturer | Marvin Matzik |
| Language | DE |
| Cycle | WiSe |
| Content | Glass structures |
| | - Introduction of the material glass (production, refinement, material characteristic) |
| | - design of facades |
| | - facade types |
| | - static calculation of glazing |
| | - static calculation of facades |
| | - load bearing behavior of glazing (plate or membrane stiffness) |
| | - vertical / horizontal glazing with safety-related requirements |
| | - glass structures |
| | - fire safety of glass facades |
| | - construction physics of facades and glazing |
| Literature | |

| Course L1447: Glass Structu | Course L1447: Glass Structures | |
|-----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Examination Form | Mündliche Prüfung | |
| Examination duration and | | |
| scale | | |
| Lecturer | Marvin Matzik | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L3270: Sustainable la | andfill design and operation |
|------------------------------|--|
| Тур | Integrated Lecture |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Examination Form | Klausur |
| Examination duration and | 60 min |
| scale | |
| Lecturer | Dr. Marco Ritzkowski |
| Language | EN |
| Cycle | SoSe |
| Content | The course introduces the development of modern waste resource management and demonstrates the importance of landfills in the context of recycling processes. Based on international (EU) and national legislation, the current landfill situation is presented and the future significance of landfills will be discussed. A central element of the course deals with the main transformation processes in the landfilled waste, the emission of gases and leachate, the long-term behaviour of landfills as well as aftercare and after-utilisation measures. Further focal points of the course are measures for the sustainable reduction of environmentally and climate-damaging emissions and aspects of landfill technology in an international context. |
| Literature | Waste Management. Bernd Bilitewski; Georg Härdtle; Klaus Marek (Eds.), ISBN: 9783540592105, Springer Verlag Lehrbuchsammlung der TUB, Signatur USH-305 Solid Waste Technology and Management. Thomas Christensen (Ed.), ISBN: 978-1-4051-7517-3, Wiley Verlag Lesesaal 2: US - Umweltschutz, Signatur USH-332 Solid Waste Landfilling - Concepts, Processes, Technologies. Cossu, R. and Stegmann, R. (Eds.), ISBN: 978-0-12-818336-6 PDF (Volltext) über TUB |

| Course L3091: Special Topics in Steel Design | |
|--|---|
| Тур | Integrated Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Examination Form | Klausur |
| Examination duration and | 90 min |
| scale | |
| Lecturer | Prof. Marcus Rutner, Nikolay Lalkovski |
| Language | DE |
| Cycle | SoSe |
| Content | |
| Literature | |

| Course L2378: Special topics | Course L2378: Special topics of civil engineering 1CP | |
|------------------------------|---|--|
| Тур | | |
| Hrs/wk | 1 | |
| CP | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Examination Form | Fachtheoretisch-fachpraktische Arbeit | |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt | |
| scale | | |
| Lecturer | Dozenten des SD B | |
| Language | DE | |
| Cycle | WiSe/SoSe | |
| Content | The course occurs only if required. The content is defined at short notice. | |
| Literature | Die Literatur wird kurzfristig festgelegt. | |

| Course L2379: Special topics | of civil engineering 2 LP |
|------------------------------|---|
| Тур | |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Examination Form | Fachtheoretisch-fachpraktische Arbeit |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt |
| scale | |
| Lecturer | Dozenten des SD B |
| Language | DE |
| Cycle | WiSe/SoSe |
| Content | The course occurs only if required. The content is defined at short notice. |
| Literature | Die Literatur wird kurzfristig festgelegt. |

| Course L2380: Special topics of civil engineering 3 LP | | |
|--|---|--|
| Тур | | |
| Hrs/wk | 3 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | |
| Examination Form | Fachtheoretisch-fachpraktische Arbeit | |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt | |
| scale | | |
| Lecturer | Dozenten des SD B | |
| Language | DE | |
| Cycle | WiSe/SoSe | |
| Content | The course occurs only if required. The content is defined at short notice. | |
| Literature | Die Literatur wird kurzfristig festgelegt. | |

| Course L2789: Structural Des | sign |
|------------------------------|---|
| Тур | Seminar |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Examination Form | Mündliche Prüfung |
| Examination duration and | 20 min |
| scale | |
| Lecturer | Dr. Jan Mittelstädt |
| Language | DE/EN |
| Cycle | SoSe |
| Content | |
| Literature | [1] Structure Systems by Heino Engel, Hantje Cantz, 3rd edition (Feb 2007), ISBN-10: 3775718761 |
| | Form and Force, Designing Efficient, Expressive Structures by Allan, E., Zalewski, W. et al, John Wiley and |
| | Sons; 1st edition (Sept 2009), ISBN-10: 047017465X |
| | [2] Peter Rice: An Engineer Imagines, ISBN-10 : 1849944237 |
| | [3] Konrad Wachsmann and the Grapevine Structure by C. Sumi et al., Park Books (Oct 2018), ISBN-10: |
| | 9783038601104 |
| | [4] Manual of Multi-Story Timber Construction by Hermann Kaufmann, Stefan Krotsch, Stefan Winter, DETAIL, |
| | (June 2018), ISBN-10: 3955533948 |
| | [5] The Art of Structural Design: A Swiss Legacy by B. Billington, Princeton University Art Museum; First Edition |
| | edition (Mar 2003), ISBN-10: 0300097867 |
| | [6] Structured Lineages: Learning from Japanese Structural Design by G. Nordenson et al, The Museum of |
| | Modern Art (Jul 2019), ISBN-10: 1633450562 |
| | [7] The Structure: Works of Mahendra Raj by V. Mehta, R. Mehndiretta, A. Huber, Park Books (Oct 2015), |
| | ISBN-10: 3038600253 |
| | |
| | |

| Courses | | | | |
|-----------------------------|---|-------------------------|----------------------------|-------------------|
| Title | | Тур | Hrs/wk | СР |
| Module Responsible | Dozenten des SD B | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Subjects of the Structural Engineering specialisation. | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the followin | g learning results | | |
| | The students are able to demonstrate their detailed knowledge exemplify the state of technology and application and discuss cri science and society. | | | • • • |
| | The students can develop solving strategies and approaches for fundamental and practical problems in structural engineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and ecor of science and society. | | | |
| | Scientific work techniques that are used can be described and cri | tically reviewed. | | |
| | The students are able to independently select methods for the p methods relate to the field of work and how the context of developments may essentially be outlined. | | | • |
| Personal Competence | | | | |
| | The students are able to condense the relevance and the struct the presentation and discussion in front of a bigger group. They c colleagues. | | | |
| - | The students are capable of independently planning and docume deadlines. This includes the ability to accurately procure the new from experts with regard to the progress of the work, and to acco | vest scientific informa | ation. Furthermore, they o | can obtain feedba |
| Workload in Hours | ndependent Study Time 180, Study Time in Lecture 0 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Study work | | | |
| Examination duration and | see FSPO | | | |
| scale | | | | |

| | Hrs/wk | СР |
|---|----------------|---------------------|
| lem-based Learning | g 4 | 6 |
| | | |
| | | |
| | | |
| esults | | |
| | | |
| eds for action in measures n approaches, me | ethods, numeri | cal models, plannir |
| | | |
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| | | |
| | | |
| subsequent discus | sion. The work | on the complex ta |
| | | |
| ory e Compulsory sory | | |
| e Co sory | / ipulsory | pulsory |

| Course L2926: Sustainable N | ature-based Coastal Protection in a Changing Climate (SeaPiaC) |
|-----------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| СР | 6 |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Lecturer | Prof. Peter Fröhle |
| Language | EN |
| Cycle | WiSe |
| Content | Climate and Climate Change General Impacts of Climate Change on Wind Regime and Water Cycle Consequences of Climate Change for Coastal Processes Coastal Protection in Taiwan and Germany Fundamentals of Climate Adaptation Nature-Based Solutions (NBS) for Coastal Protection |
| Literature | Materials provided on eLearning Platform (HOOU Platform) Depending on the main topics of the course in the respective year, the literature (recent papers) will be provided in the course-material or via StudIP. |

| Courses | |
|--|--|
| Title Adaptation to climate change in hy | Typ Hrs/wk CP draulic engineering (L2291) Project-/problem-based Learning 4 6 |
| Module Responsible | Prof. Peter Fröhle |
| Admission Requirements | None |
| Recommended Previous Knowledge | Hydrology Hydraulic Engineering |
| Educational Obiectives | After taking part successfully, students have reached the following learning results |
| Professional Competence Knowledge Skills | Climate protection and climate adaptation Insights into climate change and its regional characteristics - fundamentals, climate modelling / climate models Impacts of climate change on the components of the regional hydrological cycle Fundamentals of analysis of climate data Consequences of the impact of the climate change Measures for climate adaptation Assessment, prioritization and communication of adaptation measures Fundamentals of the analysis of hydrometeorological and hydrological data |
| Personal Competence Social Competence Autonomy | Working in heterogenous groups Working with different scientific / non-scientific disciplines Self reflection |
| | Autonomous work on complex tasks |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Credit points | |
| Course achievement | |
| Examination | |
| Examination duration and scale | Preparation of a written report and a presentation of a complex task. |
| • | Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory |
| | Civil Engineering: Specialisation Structural Engineering: Elective Compulsory |
| | Water and Environmental Engineering: Specialisation Cities: Elective Compulsory |
| | Water and Environmental Engineering: Specialisation Environment: Elective Compulsory |
| | Water and Environmental Engineering: Specialisation Water: Elective Compulsory |

| Course L2291: Adaptation to | climate change in hydraulic engineering |
|-----------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| СР | 6 |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Lecturer | Prof. Peter Fröhle |
| Language | DE |
| Cycle | WiSe |
| Content | Climate protection and climate adaptation Findings on climate change and its regional characteristics: fundamentals of climate change, climate modelling / climate models Impacts of climate change on the components of the regional hydrological cycle(climate science view) Fundamentals of the analysis of climate data Concequences of the impacts of climate change (ingenieering science view) Measures for climate change adaptation Assessment, prioritization and communication of measures Fundamentals of analysis of hydrometeorological and hydrological data |
| Literature | Wird bereitgestellt über die HOOU - eLearning Plattform abhängig von den jeweils schwerpunktmäßig behandelten Fragestellungen wird das Schrifttum (aktuelle Paper) in der Veranstaltung bzw. über StudIP zur Verfügung gestellt. |

| House Higher House | rn discretization methods in stru | | | | |
|---|---|--|--------|----|--|
| Courses | | | | | |
| Title | | Тур | Hrs/wk | СР | |
| Modern discretization methods in structural mechanics (L3043) | | Lecture | 2 | 3 | |
| Modern discretization methods in s | tructural mechanics (L3044) | Recitation Section (small) | 2 | 3 | |
| Module Responsible | Prof. Bastian Oesterle | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous Knowledge | Finite Element MethodsFlächentragwerke | | | | |
| Educational Objectives | After taking part successfully, students have rea | ached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | After successful completion of this module, students can express the basic aspects of modern discretization methods in structura mechanics. | | | | |
| Skills | After successful completion of this module, the students will be able to use and further improve modern discretization methods for problems in structural mechanics. | | | | |
| Personal Competence | | | | | |
| Social Competence | Students can | | | | |
| | participate in subject-specific and interdisciplinary discussions, defend their own work results in front of others | | | | |
| | | | | | |
| | promote the scientific development of co | promote the scientific development of colleagues | | | |
| | Furthermore, they can give and accept pr | ofessional constructive criticism | | | |
| Δυτοροπγ | Students are able to gain knowledge of the subject area from given and other sources and apply it to new problems. Furthermore | | | | |
| , according | Students are able to gain knowledge of the subject area from given and other sources and apply it to new problems. Furthermor they are able to structure the solution process for problems in the area of modern discretization methods. | | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Leo | ture 56 | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and | 90 min | | | | |
| scale | | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Enginee | ering: Elective Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical En | ngineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Structural Engin | neering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Computational | Engineering: Elective Compulsory | | | |
| | Theoretical Mechanical Engineering: Specialisat | on Simulation Technology: Elective Compulso | ry | | |

| Тур | Lecture |
|-------------------|---|
| Hrs/wk | |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Bastian Oesterle |
| Language | EN |
| Cycle | WiSe |
| Content | The course covers variational formulations, various locking phenomena and alternative formulations for finite elements an modern discretization schemes in the context of structural mechanics, like isogeometric analysis. variational formulation of finite elements, mixed variational principles geometrical and material locking effects in structural and solid mechanics hybrid-mixed and enhanced assumed strain finite element formulations, reduced integration and stabilization, DSG method u-p formulations patch test, stability, convergence linear and non-linear analyses introduction to isogeometric analysis isogeometric beam, plate and shell formulations locking effects and their avoidance in modern, smooth discretization schemes, like isogeometric analysis |
| Literature | lecture notes and selected scientific papers O.C. Zienkiewicz, R.L. Taylor, and J.Z. Zhu: Finite Element Method: Its Basis and Fundamentals. Elsevier, 2013. J. Austin Cottrell, Thomas J. R Hughes, Yuri Bazilevs: Isogeometric Analysis: Toward Integration of CAD and FEA. Wiley, 2009 |

| Course L3044: Modern discre | urse L3044: Modern discretization methods in structural mechanics | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Bastian Oesterle | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | |
|------------------------------------|--|--|--------|----|
| Title | | Тур | Hrs/wk | СР |
| Scientific Working in Computationa | Engineering (L2764) | Project-/problem-based Learning | 4 | 6 |
| Module Responsible | Prof. Kay Smarsly | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge in scientific writing. String interest in topic | s related to computing in civil engine | ering. | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the for | ollowing learning results | | |
| Professional Competence | | | | |
| Personal Competence | course instructors and in collaboration with each other, the students will also learn to understand the complex process of scientific thinking, being able to accurately plan, implement and analyze scientific projects, such as prospective master theses. A project will be conducted throughout the semester, which will contribute to the grade. Since scientific writing is of particular importance in this course, a scientific paper will be developed based, which is a prerequisite for the final examination. The paper will be writter based on the project conducted within this course. Project meetings in small groups, presentations, and critical discussions or scientific publications are further key activities. The students will be capable (i) of solving a scientific problem following a scientific methodology, (ii) of documenting their work effectively in the form of a paper, and (iii) of sharing their work in a presentation. | | | |
| Autonomy | The students will be able to extend their knowledge and apply it to solve scientific problems by working independently in a project | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | 10 pages of work with 15-minute oral presentation | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Water and Traffic: Elective | Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: | Elective Compulsory | | |
| | Civil Engineering: Specialisation Coastal Engineering: Elect | ve Compulsory | | |
| | Civil Engineering: Specialisation Structural Engineering: Ele | ctive Compulsory | | |
| | Civil Engineering: Specialisation Computational Engineering | : Elective Compulsory | | |
| | Computer Science: Specialisation II: Intelligence Engineerin | g: Elective Compulsory | | |

| Course L2764: Scientific Wor | rking in Computational Engineering |
|------------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| СР | 6 |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Lecturer | Prof. Kay Smarsly |
| Language | EN |
| Cycle | WiSe/SoSe |
| Content | In the course, a scientific problem of practical relevance will first be defined, taking into account the interests of the students participating in the course. The scientific problem will then systematically be solved within the framework of a comprehensive project. The principles of scientific working will be taught based on the scientific problem defined previously. As an integral part of scientific working, fundamentals of scientific writing will be presented and applied to a scientific paper to be written during the course. Topics related to scientific writing include structuring in scientific writing (structuring the abstract, the introduction, the main part, the summary and conclusions, and the acknowledgments and references) and recommendations on effective scientific writing (principles of composition, use of English in scientific writing, useful tips, creating figures, writing in mathematics, referencing, and formal email correspondence). A final paper and a final presentation will be assembled by the students. |
| Literature | Smarsly, K. & Dragos, K., 2019. Scientific Writing in Engineering. Tredition, Hamburg, Germany. |

| Module M1956: Build | ing and Excavation Law | | | |
|------------------------------------|--|---|----------------------------|--------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Construction law BGB and VOB - la | w in (excavation) practice (L3182) | Lecture | 2 | 3 |
| Construction disputes from constru | ction (excavation) practice (L3181) | Lecture | 2 | 3 |
| Module Responsible | Prof. Jürgen Grabe | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Complete modules: Geotechnics I-III | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have r | eached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students will gain knowledge of | | | |
| | the history of civil engineering law, | | | |
| | basics of foundation and civil engineering | ng law, | | |
| | legal aspects of technical regulations in | civil engineering (with case studies), | | |
| | the civil engineering contract, | | | |
| | the liability of the designer and contract | tor in civil engineering, | | |
| | the subsoil risk and the system risk, | | | |
| | the total debt in (civil) engineering law, | | | |
| | the (construction) conflict, dispute avoidance models and the construction process, the systematics of construction contract law, the BGB construction contract law, | | | |
| | | | | |
| | | | | |
| | responsibilities on the construction site | | | |
| | remuneration and contract management | 1, | | |
| | liability for defects, public programment low | | | |
| | public procurement law Disturbed construction processes: How | much monoy am Lontitlad to? | | |
| | Correct calculation of supplements. | much money and entitled to? | | |
| | • concerculation of supplements. | | | |
| Skills | Students learn to apply legal aspects in planr | ing and construction in a legally balance | d way. Students learn l | now to use legal a |
| | construction management aspects in practice | (planning and construction) on the cons | struction site in a target | ted manner and h |
| | to manage the construction project optimally. | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Students can work in groups and support each | n other in finding solutions. | | |
| | | | | |
| Autonomy | Students are able to assess their own strength | ns and weaknesses and organize their tim | e and learning manage | ment based on th |
| Workload in Hours | | ecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Oral exam | | | |
| Examination duration and | 30 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Engin | eering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical | Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Structural Eng | gineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Water and Tra | affic: Elective Compulsory | | |
| | Civil Engineering: Specialisation Computationa | al Engineering: Elective Compulsory | | |

| Course L3182: Construction | Course L3182: Construction law BGB and VOB - law in (excavation) practice | | |
|----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Günther Schalk | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | | | |
| Literature | Literatur: | | |
| | - Folienskript (in der Vorlesung erhältlich) | | |
| | - Fuchs/Maurer/Schalk: Handbuch Tiefbaurecht | | |

| Course L3181: Construction | urse L3181: Construction disputes from construction (excavation) practice | | |
|----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Ingo Junker | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | | | |
| Literature | | | |

| C | | | | | |
|--|--|--|-----------------|--------------------|--|
| Courses | | | | | |
| Title | | Тур | Hrs/wk | СР | |
| Coastal- and Flood Protection (L08) Coastal- and Flood Protection (L14) | - | Lecture | 2 1 | 3 1 | |
| Maintenance and Defence of Flood | - | Project-/problem-based Learning Lecture | 2 | 2 | |
| Module Responsible | | | | | |
| Admission Requirements | | | | | |
| Recommended Previous | | | | | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students have reached the | following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | The students have the capability to define and explain in detail the important aspects of erosion protection and flood pro | | | | |
| | and are able to apply the aspects to practical coastal protection problems. They are able to design and dimension | | | dimension importa | |
| | coastal protection measures from the functional and from the constructional point of view. | | | | |
| CL 111 | | | | | |
| SKIIIS | The students are able to select design approaches for the functional and constructional design of erosion and flood protection | | | | |
| | measures and apply these approaches to practical design | Lasks. | | | |
| Personal Competence | | | | | |
| Social Competence | The students are able to deploy their gained knowledge | e in applied problems such as the fun | ctional and co | onstructive design | |
| | coastal and flood protection structures. Additionaly, they | will be able to work in team with engine | eers of other d | lisciplines. | |
| Autonomy | The students will be able to independently extend their ki | nowledge and apply it to new problems | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and | The duration of the examination is 130 min. The exami | nation includes tasks with respect to | the general ι | understanding of t | |
| scale | lecture contents and calculations tasks. | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Engineering: Con | npulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering | : Elective Compulsory | | | |
| | Civil Engineering: Specialisation Structural Engineering: E | lective Compulsory | | | |
| | Environmental Engineering: Specialisation Environment a | nd Climate: Elective Compulsory | | | |
| | Environmental Engineering: Specialisation Water Quality a | and Water Engineering: Elective Compu | Ilsory | | |
| | Water and Environmental Engineering: Specialisation Env | ironment: Elective Compulsory | | | |
| | Water and Environmental Engineering: Specialisation Wat | er: Elective Compulson | | | |

| Course L0808: Coastal- and F | lood Protection |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Peter Fröhle |
| Language | EN |
| Cycle | WiSe |
| Content | Protection of sandy coasts |
| | Sediment transport Morphology Technical solution for the protection of sandy coasts Construction in direction of the coast Constructions perpendicular to the coast Other Concepst Calculation approaches and numerical models Flood Protection Classification of constructions / measures Dikes Dunes Foreland - constructions Flood-Protection Walls |
| | Drainage of the hinterland Vorlesungsumdruck Coastal Engineering Manual CEM |

| Course L1415: Coastal- and I | urse L1415: Coastal- and Flood Protection | | |
|------------------------------|---|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Peter Fröhle | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Course L1411: Maintenance | Course L1411: Maintenance and Defence of Flood Protection Structures | | |
|---------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Dr. Olaf Müller | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | Dike protection Maintennance of flood protection measures | | |
| Literature | Vorlesungsumdruck | | |

| Courses | | | | |
|-----------------------------------|--|--|-----------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Waste and Environmental Chemist | - | Practical Course | 2 | 2 |
| Biological Waste Treatment (L0318 | | Project-/problem-based Learning | 3 | 4 |
| Module Responsible | Prof. Kerstin Kuchta | | | |
| Admission Requirements | None | | | |
| | chemical and biological basics | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached | the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The module aims possess knowledge concerning the design and layout of anaerobic and aerobic waste tree plants for biological waste treatment plants and expl | atment plants in detail, describe different te | | |
| Skills | The students are able to discuss the compilation of d control measurements. The students can recherché and plan additional tests. They are capable of reflect | and evaluate literature and date connected | | |
| Personal Competence | | | | |
| | Students can participate in subject-specific and inte | rdisciplinary discussions, develop cooperate | ed solutions a | and defend their |
| | work results in front of others and promote the sc accept professional constructive criticism. | | | |
| Autonomy | Students can independently tap knowledge from lite are capable, in consultation with supervisors as well steps on this basis. Furthermore, they can define ta potential social, economic and cultural impact. | as in the interim presentation, to assess the | ir learning lev | vel and define fur |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture | 70 | | |
| Credit points | | | | |
| Course achievement | | escription | | |
| | Yes None Subject theoretical and | | | |
| | practical work | | | |
| Examination | Presentation | | | |
| Examination duration and | Elaboration and Presentation (15-25 minutes in group | os) | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Engineering: | Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engine | ering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Structural Engineering | ng: Elective Compulsory | | |
| | Civil Engineering: Specialisation Water and Traffic: El | ective Compulsory | | |
| | Bioprocess Engineering: Specialisation A - General Bi | oprocess Engineering: Elective Compulsory | | |
| | Chemical and Bioprocess Engineering: Specialisation | General Process Engineering: Elective Comp | oulsory | |
| | Chemical and Bioprocess Engineering: Specialisation | Bioprocess Engineering: Elective Compulsor | У | |
| | Chemical and Bioprocess Engineering: Specialisation | • • | | |
| | Chemical and Bioprocess Engineering: Specialisation | | tive Compuls | ory |
| | Environmental Engineering: Core Qualification: Comp | | | |
| | International Management and Engineering: Specialis | | lsory | |
| | Process Engineering: Specialisation Environmental Pr | | | |
| | Water and Environmental Engineering: Specialisation | | | |
| | Water and Environmental Engineering: Specialisation | | | |

| Course L0328: Waste and En | vironmental Chemistry |
|----------------------------|--|
| Тур | Practical Course |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Kerstin Kuchta |
| Language | EN |
| Cycle | WiSe |
| Content | The participants are divided into groups. Each group prepares a transcript on the experiment performed, which is then used as basis for discussing the results and to evaluate the performance of the group and the individual student. In some experiments the test procedure and the results are presented in seminar form, accompanied by discussion and results evaluation. Experiments ar e.g. Screening and particle size determination Fos/Tac AAS Chalorific value |
| Literature | Scripte |

| Course L0318: Biological Wa | ste Treatment |
|-----------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Kerstin Kuchta |
| Language | EN |
| Cycle | WiSe |
| Content | Introduction biological basics determination process specific material characterization aerobic degradation (Composting, stabilization) anaerobic degradation (Biogas production, fermentation) Technical layout and process design Flue gas treatment Plant design practical phase |
| Literature | |

| Module M2025: Finite | element modeling of structur | es | | |
|-------------------------------------|--|---|------------------|----------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Finite element modeling of structur | es (L3046) | Lecture | 2 | 3 |
| Finite element modeling of structur | es (L3047) | Recitation Section (small) | 2 | 3 |
| Module Responsible | Prof. Bastian Oesterle | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Finite Element MethodsThin-walled structures | | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After successful completion of this module, s | tudents can express the basic aspects of modelli | ng of structures | with finite elements |
| Skills | After successful completion of this module, the students will be able to model structures with finite elements and to analys structures using appropriate computational methods. | | | |
| Personal Competence | | | | |
| Social Competence | Students can | | | |
| | participate in subject-specific and interdisciplinary discussions, | | | |
| | • defend their own work results in front | of others | | |
| | promote the scientific development of | f colleagues | | |
| | • Furthermore, they can give and accept | t professional constructive criticism | | |
| Autonomy | | subject area from given and other sources and a ss for problems in the area of finite element mode | | |
| Workload in Hours | Independent Study Time 124, Study Time in | Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | written elaboration of a project work (10-15 | pages) | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Computation | nal Engineering: Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Coastal Eng | ineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Geotechnica | al Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Structural E | ngineering: Elective Compulsory | | |
| | Theoretical Mechanical Engineering: Speciali | sation Simulation Technology: Elective Compulso | rv | |

| ourse L3046: Finite element modeling of structures | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Bastian Oesterle | |
| Language | EN | |
| Cycle | WiSe | |
| Content | Basic phenomena and aspects of the finite element modelling of structures are discussed. Besides theoretical decription of the phenomena and methods, a strong focus is on the practical use a commercial finite element software within computer-based exercises. The covered topics are: finite element modeling of trusses/beams/frames, plates subject to in-plane/out-of-plane loading and shells convergence properties of displacements and stresses singularities locking effects critical assessment, interpretation and check of results mixed-dimensional coupling of finite elements geometrically linear and non-linear, and material linear and non-linear analyses stability: bifurcation and snap-through problems dynamic problems, modal analyses | |
| Literature | Vorlesungsmanuskript, Vorlesungsfolien | |

| Course L3047: Finite elemen | urse L3047: Finite element modeling of structures | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Bastian Oesterle | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | | |
|-----------------------------------|--|--|------------------------|-----------------|------------|
| Title | | Тур | Hrs/v | vk CP | |
| Nodeling of Subsurface Processes | (L2731) | Recitation Section | (small) 3 | 3 | |
| Subsurface Solute Transport (L272 | 8) | Lecture | 2 | 2 | |
| Subsurface Solute Transport (L272 | 9) | Recitation Section | (large) 1 | 1 | |
| Module Responsible | Prof. Nima Shokri | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Basic Mathematics, Hydrology | | | | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students ha | ave reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | Upon completion of this module, the st | udents will understand the mechanisms | controlling solute tra | ansport in soil | and natu |
| | porous media and will be able to work wit | h the equations that govern the fate and | transport of solutes i | n porous media | a. Analyti |
| | numerical and experimental tools and techniques will be used in this module. | | | | |
| | | | | | |
| Skills | In addition to the physical insights, the st | | | | |
| | this module. This provides them with an excellent opportunity to improve their skills on multiple fronts which will be useful in the | | | | |
| | future career. | | | | |
| Personal Competence | | | | | |
| | Teamwork & problem solving | | | | |
| Autonomy | The students will be involved in writing individual reports and presentation. This will contribute to the students' ability a | | | | |
| | willingness to work independently and res | sponsibly. | | | |
| Workload in Hours | Independent Study Time 96, Study Time i | n Lecture 84 | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Subject theoretical and practical work | | | | |
| Examination duration and | Report | | | | |
| scale | | | | | |
| Assignment for the | Civil Engineering: Specialisation Structura | I Engineering: Elective Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechr | nical Engineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Coastal E | ingineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Water and Traffic: Elective Compulsory | | | | |
| | Civil Engineering: Specialisation Computational Engineering: Elective Compulsory | | | | |
| | Chemical and Bioprocess Engineering: Te | chnical Complementary Course: Elective (| Compulsory | | |
| | Environmental Engineering: Core Qualific | ation: Compulsory | | | |
| | Process Engineering: Specialisation Enviro | onmental Process Engineering: Elective Co | ompulsory | | |
| | Process Engineering: Specialisation Proce | ss Engineering: Elective Compulsory | | | |
| | Water and Environmental Engineering: Sp | ecialisation Water: Compulsory | | | |
| | | | | | |

| Course L2731: Modeling of S | Course L2731: Modeling of Subsurface Processes | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 3 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | |
| Lecturer | Dr. Milad Aminzadeh | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | Basic usage and background of chosen computer software to calculate flow and transport in the saturated and unsaturated zone and to analyze field data like pumping test data | | |
| Literature | | | |

| Course L2728: Subsurface So | olute Transport |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Nima Shokri |
| Language | EN |
| Cycle | WiSe |
| Content | Basic physical properties of soil: Definition and quantification; Liquid flow in soils (Darcy's law); Solute transport in soils; Practical analysis to measure dispersion coefficient in soil under different boundary conditions; Advanced topics (e.g. Application of Artificial Intelligence to predict soil salinization) |
| Literature | - Environmental Soil Physics, by Daniel Hillel - Soil Physics, Sixth Edition, by William A. Jury and Robert Horton |

| Course L2729: Subsurface So | urse L2729: Subsurface Solute Transport | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Hannes Nevermann | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

Specialization Computational Engineering

| Courses | | | | |
|---|--|---------------------------------------|--------|----|
| Fitle | | Тур | Hrs/wk | СР |
| Steel and Composite Structures (L1 | - | Lecture | 2 | 2 |
| Steel and Composite Structures (L1 Steel Bridges (L1097) | 205) | Recitation Section (large) Lecture | 2 2 | 2 |
| - | Prof. Marcus Rutner | Lecture | Z | Z |
| Module Responsible Admission Requirements | None | | | |
| - | Basics of steel construction (i.e. Steel Structures I and I | BUBC) | | |
| Knowledge | basics of steel construction (i.e. steel structures I and I | , bobc) | | |
| - | After taking part successfully, students have reached th | e following learning results | | |
| Professional Competence | | · · · · · · · · · · · · · · · · · · · | | |
| - | After successful completition, students can | | | |
| - | · · · · · · · · · · · · · · · · · · · | | | |
| | describe the phenomenon of local buckling | | | |
| | explain warping torsion | | | |
| | illustrate the behaviour of composite structures | | | |
| | specify the principles in design of composite sttr | | | |
| | sketch the contructions of steel and composite b | ridges | | |
| Skills | After successful participation students are able to | | | |
| | check stiffened and unstiffened plated structures | | | |
| | • recognize and verify warping tosion in strucures | | | |
| | design composite structures | | | |
| | design bridges and o perform the detailing | | | |
| Porconal Competence | | | | |
| Personal Competence Social Competence | _ | | | |
| Autonomy | | | | |
| · · · · · · · · · · · · · · · · · · · | Independent Study Time 96, Study Time in Lecture 84 | | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | Written exam | | | |
| Examination duration and | 180 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering | Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineer | ng: Elective Compulsory | | |
| - | Civil Engineering: Specialisation Coastal Engineering: E | • • • | | |
| | Civil Engineering: Specialisation Water and Traffic: Elec | | | |
| | Civil Engineering: Specialisation Computational Engineer | | | |
| | International Management and Engineering: Specialisat | • | | |

| Course L1204: Steel and Con | Course L1204: Steel and Composite Structures | | |
|-----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Marcus Rutner | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Local-buckling of plated structures Warping torsion Composite-girders, -columns, -slabs, -bridges Principles in composite constructions Bridge-design and -construction | | |
| Literature | Petersen, C.: Stahlbau, 4.Auflage 2013, Springer-Vieweg Verlag Minnert, J. Wagenknecht, G.: Verbundbau-Praxis - Berechnung und Konstruktion nach Eurocode 4, 2.Auflage 2013, Bauwerk Beuth Verlag | | |

| Course L1205: Steel and Con | ourse L1205: Steel and Composite Structures | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Marcus Rutner | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Course L1097: Steel Bridges | | | |
|-----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | | | |
| Language | | | |
| Cycle | | | |
| Content | Lecture Contents ,Steel Bridge Construction' DrIng. Jörg Ahlgrimm | | |
| | - From tendering and contracting to completion - the development of a steel bridge | | |
| | - Contents of a bridge static - structural details, examples of analysis in detail: | | |
| | -> effective width in regard to the longitudinal stiffeners | | |
| | -> Bearing point, bearing stiffener | | |
| | -> Crossbeam breakthrough, crossbeam reinforcement | | |
| | -> Analysis of the Rib-to-Floorbeam (RF) connection (web-tooth of the floorbeam between trapezoidal shaped Ribs) | | |
| | - Steel grades, -designation, testing methods and approval certificates | | |
| | - Nondestructive weld inspecting | | |
| | - Corrosion protection | | |
| | - Bridge bearing - types, format, function, dimensioning, installation | | |
| | - Expansion Joints | | |
| | - Oscillation of bridge hangers and cables - oscillation damper | | |
| | - Opening bridges- Detailed reviews to different assembling procedures and - implements | | |
| | - Selective damage events | | |
| | Requirements: Basic knowledge in the calculation, dimensioning, and construction of structural elements and joints of constructional steelwork | | |
| Literature | | | |
| | Herbert Schmidt, Ulrich Schulte, Rainer Zwätz, Lothar Bär: Ausführung von Stahlbauten | | |
| | Petersen, Christian: Stahlbau, Abschnitt Brückenbau | | |
| | Ahlgrimm, J., Lohrer, I.: Erneuerung der Eisenbahnüberführung in Fulda-Horas über die Fulda, Stahlbau 74 (2005), Heft 2, S. 114 | | |

| 2 | | | | |
|--|---|---|----------------------|-------------------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Numerical Methods in Geotechnics (L0375) | | Lecture | 3 | 3 |
| Advanced Foundation Engineering | · · | Lecture | 2 1 | 2 1 |
| Advanced Foundation Engineering | | Recitation Section (large) | 1 | Ţ |
| Module Responsible | | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Geotechnics I and II, Mathematics I-III | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the | ne following learning results | | |
| Professional Competence | | | | |
| Knowledge | After successfully completing the module, students will | be able to | | |
| | describe individual procedures for the geotechni | al monitoring of civil engineering mea | sures | |
| | reproduce exploration and investigation method | | 54105, | |
| | select suitable types of field and laboratory tests | | their results | |
| | state the differences between various stress and | | | variants of the stre |
| | and distortion tensor, | | igniticative of inte | |
| | outline the standard and special soil mechanics | ests used to determine the stress-stra | in behavior of soi | il |
| | describe continuum models and the resulting bo | | | , |
| | as well as define boundary value problems from | | n such a way tha | it they can be solv |
| | unambiguously. | the field of geoteenined engineering i | | it they can be solv |
| | unambiguousiy. | | | |
| Skills | Students will be able to | | | |
| | dimension vertical drains for soil improvement o calculate depth compaction using various approp apply principles of horizontal bearing capacity of verify the internal and external stability of fluid-s evaluate the boundary conditions for the des excavation, perform, evaluate and interpret tests for the des computationally implement numerical algorithm select and apply the types of analyses dependin determine appropriate model parameters for dif of soils. | priate methods, piles, upported diaphragm walls, ign of a deep excavation and desig cription and classification of soils acco s to solve boundary value problems, g on the degree of saturation, the impa | rding to applicabl | e standards, rial behavior |
| Demonst Commentance | | | | |
| Personal Competence | Students can work in groups and support each ather in | finding colutions | | |
| Sucial Competence | Students can work in groups and support each other in | | | |
| Autonomy | Students are able to assess their own strengths and we | aknesses and, based on this, organize | their time and le | arning manageme |
| | and think in terms of processes. | | | |
| Weddeed in He | Independent Study Time 06. Study Time in Laster 201 | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 | | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineer | • • • | | |
| | Civil Engineering: Specialisation Coastal Engineering: C | | | |
| | Civil Engineering: Specialisation Water and Traffic: Elec | tive Compulsory | | |
| | Civil Engineering: Specialisation Computational Enginee | ering: Compulsory | | |
| | International Management and Engineering: Specialisat | ion II. Civil Engineering: Elective Comp | ulsory | |

| Course L0375: Numerical Me | Course L0375: Numerical Methods in Geotechnics | | |
|----------------------------|---|--|--|
| Тур | cture | | |
| Hrs/wk | 3 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | |
| Lecturer | Dr. Hans Mathäus Stanford | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Topics: | | |
| | Introduction to numerical soil mechanics Introduction to numerical mathematics Finite Element Method (analysis procedures, algorithms) Finite Element Method (application in geotechnical engineering) | | |
| Literature | Wriggers P. (2001): Nichtlineare Finite-Elemente-Methoden. Springer Wriggers P. (2008): Nonlinear Finite Element Methods. Springer Deutsche Gesellschaft für Geotechnik e.V. (Hrsg., 2014): Empfehlungen des Arbeitskreises "Numerik in der Geotechnik". Ernst & Sohn | | |

| Course L0497: Advanced Fou | Indation Engineering |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Jürgen Grabe |
| Language | DE |
| Cycle | WiSe |
| Content | Vertical drains Piles Ground improvement (Deep Compaction, Soil mixing) Vibration driving Jet grouting Slurry wall Deep excavation |
| Literature | EAK (2002): Empfehlungen für Küstenschutzbauwerke EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke EAB (1988): Empfehlungen des Arbeitskreises Baugruben Grundbau-Taschenbuch, Teil 1-3, (1997), Ernst & Sohn Verlag |

| Course L0498: Advanced Fou | ourse L0498: Advanced Foundation Engineering | | |
|----------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Jürgen Grabe | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| | | 25 | | | | |
|--|--|---|---|--|--------------------|--------------------|
| Courses | | | | | | |
| litle . | | | т | Тур | Hrs/wk | СР |
| Concrete Structures (L0579) | | | | Seminar | 1 | 1 |
| Structural Concrete Members (L05 | (7) | | L | ecture | 2 | 3 |
| Structural Concrete Members (L05 | /8) | | R | ecitation Section (large) | 2 | 2 |
| Module Responsible | NN | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Basics of structural | analysis, conception a | nd dimensioning of struc | tural concrete | | |
| Knowledge | | | | | | |
| | Modules: Reinforced | d Concrete Structures I | +II, Structural Analysis I- | +II, Mechanics I+II | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Educational Objectives | After taking part su | iccessfully students ha | ve reached the following | learning results | | |
| Professional Competence | , iter taking part ba | iecessiany, stadents na | ie reached the following | i carring results | | |
| | The students broad | lon their skills in struct | | ally in the field of buildings | (houses roofs ha | alls) They dispose |
| Knowledge | | | | and structural members t | | |
| | the knowledge for t | the conception and des | ight of concrete buildings | | | |
| Skills | Skills The students are able to apply procedures of the conception and dimensioning to to practical problems of | | al problems of st | ructural engineeri | | |
| | They are capable to draft concrete buildings and to design them for general action effects and to pla | | | ects and to plan | their detailing a | |
| | execution. Moreove | er, they can make desig | n and construction sket | ches and draw up technica | l descriptions. | |
| Demonal Commetence | | | | | | |
| Personal Competence | | | | | | |
| | | | | | | |
| Social Competence | The students are ab | Die to obtain results of . | nigh quality in teamwork | | | |
| | | | | sioning tasks of structures | under the guidance | e of tutors. |
| Autonomy | The students are ab | ble to carry out comple: | x conception and dimens | | under the guidand | e of tutors. |
| Autonomy | The students are ab | | x conception and dimens | | under the guidanc | e of tutors. |
| Autonomy | The students are ab Independent Study 6 | ble to carry out comple: Time 110, Study Time | x conception and dimens | | under the guidanc | e of tutors. |
| Autonomy Workload in Hours | The students are ab Independent Study 6 Compulsory Bonus | ble to carry out comple: Time 110, Study Time Form | x conception and dimens in Lecture 70 Description | sioning tasks of structures | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement | The students are ab Independent Study 6 Compulsory Bonus No None | ble to carry out comple: Time 110, Study Time | x conception and dimens in Lecture 70 Description | | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination | The students are ab Independent Study 6 Compulsory Bonus No None Written exam | ble to carry out comple: Time 110, Study Time Form | x conception and dimens in Lecture 70 Description | sioning tasks of structures | under the guidanc | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and | The students are ab Independent Study 6 Compulsory Bonus No None Written exam | ble to carry out comple: Time 110, Study Time Form | x conception and dimens in Lecture 70 Description | sioning tasks of structures | under the guidanc | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination | The students are ab Independent Study 6 Compulsory Bonus No None Written exam | ble to carry out comple: Time 110, Study Time Form | x conception and dimens in Lecture 70 Description | sioning tasks of structures | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale | The students are ab Independent Study 6 Compulsory Bonus No None Written exam 120 minutes | ble to carry out comple: Time 110, Study Time Form Presentation | x conception and dimens in Lecture 70 Description | sioning tasks of structures | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | The students are ab Independent Study 6 Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Sp | ble to carry out comple: Time 110, Study Time Form Presentation Specialisation Structural | x conception and dimens in Lecture 70 Description Es werden 2 Re | sioning tasks of structures | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | The students are ab Independent Study 6 Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Sp Civil Engineering: Sp | ble to carry out comple: Time 110, Study Time Form Presentation Specialisation Structural Specialisation Geotechn | x conception and dimens in Lecture 70 Description Es werden 2 Re Engineering: Compulsor | sioning tasks of structures | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | The students are ab Independent Study 6 Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Sp Civil Engineering: Sp Civil Engineering: Sp | ble to carry out comple: Time 110, Study Time Form Presentation Specialisation Structural Specialisation Geotechn Specialisation Coastal En | x conception and dimens in Lecture 70 Description Es werden 2 Re Engineering: Compulsor ical Engineering: Elective | sioning tasks of structures eferate ausgegeben ry e Compulsory ipulsory | under the guidand | e of tutors. |
| Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the | The students are ab Independent Study 6 Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Sp Civil Engineering: Sp Civil Engineering: Sp Civil Engineering: Sp Civil Engineering: Sp | ble to carry out complex Time 110, Study Time Form Presentation Specialisation Structural Specialisation Geotechn Specialisation Coastal Er Specialisation Water and | x conception and dimens in Lecture 70 Description Es werden 2 Re Engineering: Compulsor ical Engineering: Elective ngineering: Elective Com | sioning tasks of structures eferate ausgegeben ry e Compulsory ipulsory lsory | under the guidand | e of tutors. |

| Course L0579: Concrete Stru | ictures |
|-----------------------------|---|
| Тур | Seminar |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | NN |
| Language | DE |
| Cycle | WiSe |
| Content | With help of a project teamwork the subjects of the course "Concrete Structures" is practiced, discussed and presented. |
| Literature | - Projektbezogene Unterlagen werden abgegeben. |

| Course L0577: Structural Cor | ncrete Members |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | NN |
| Language | DE |
| Cycle | WiSe |
| Content | skyscrapers: structural elements actions on structrues bracing systems design orf slabs (line and point supported plates and floor slabs) membranes and deep beams folded plates and shells truss models reinforced and prestressed members |
| | Vorlesungsunterlagen können im STUDiP heruntergeladen werden Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003 Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992 Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin, 1973 Schlaich J.; Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst & Sohn, Berlin, 1998 Dames KH.: Rohbauzeichnungen Bewehrungszeichnungen. Bauverlag, Wiesbaden 1997 |

| Course L0578: Structural Con | ncrete Members |
|------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | NN |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Iodule M1748: Const | |
|--|---|
| Courses | |
| Fitle Construction Robotics (L2867) | TypHrs/wkCPProject-/problem-based Learning66 |
| Module Responsible | Prof. Kay Smarsly |
| Admission Requirements | None |
| Recommended Previous | Basics of project-oriented programming |
| Knowledge | |
| Educational Objectives | After taking part successfully, students have reached the following learning results |
| Professional Competence | |
| Knowledge | Basics of robotics |
| | Applications in civil engineering |
| | Kinematics |
| Skills | Use of specific hardware |
| | Development of software routines |
| | Python programming language |
| | Image processing |
| | Basics of localization (LIDAR, SLAM) |
| Personal Competence | |
| Social Competence | |
| | Communication skills |
| Autonomy | Independent work |
| | Independent decisions |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 |
| Credit points | 6 |
| Course achievement | None |
| Examination | Written elaboration |
| Examination duration and | ca. 10 Seiten |
| scale | |
| • | Civil Engineering: Specialisation Structural Engineering: Elective Compulsory |
| Following Curricula | |
| | Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory |
| | Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory |
| | Civil Engineering: Specialisation Computational Engineering: Elective Compulsory |
| | Computer Science: Specialisation II: Intelligence Engineering: Elective Compulsory |
| | Mechatronics: Core Qualification: Elective Compulsory |
| | Theoretical Mechanical Engineering: Specialisation Robotics and Computer Science: Elective Compulsory |

| Тур | Project-/problem-based Learning |
|------------|--|
| Hrs/wk | |
| CP | |
| | Independent Study Time 96, Study Time in Lecture 84 |
| | Prof. Kay Smarsly, Jan Stührenberg |
| Language | |
| | |
| Cycle | |
| Content | 1. Introduction: Robotics in civil engineering |
| | 2. Presentation of potential topics |
| | 3. Programming of algorithms in Python |
| | 4. Application of software systems: LINUX distribution, ROS, CloudCompare, |
| | 5. Application of hardware systems: Petoi Bittle Dog, Raspberry Pi, Arduino, sensing |
| | 6. Topics considered for robotics using the Petoi Bittle Dog: |
| | 1. Movement |
| | 2. Use of sensors (camera, infrared,) |
| | 3. Data structures/data acquisition |
| | 4. Programming |
| | 7. Topics technically relevant to building inspection: |
| | 1. Geodetic evaluations |
| | 2. Image processing |
| | 3. Localization |
| | |
| | |
| Literature | Bock/Linner: Construction Robotics |
| | Verl et al.: Soft Robotics |
| | Pasquale: New Laws of robotics |

| Courses | | | | |
|--|---|--|------------------------|------------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Modeling of Subsurface Processes Subsurface Solute Transport (L272 | | Recitation Section (sma Lecture | II) 3 2 | 3 2 |
| Subsurface Solute Transport (L272 Subsurface Solute Transport (L272 | | Recitation Section (larg | | 1 |
| Module Responsible | | | | |
| Admission Requirements | None | | | |
| | Basic Mathematics, Hydrology | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students ha | ave reached the following learning results | | |
| Professional Competence | | | | |
| | Upon completion of this module, the st | udents will understand the mechanisms con | trolling solute transp | ort in soil and natu |
| - | porous media and will be able to work with | th the equations that govern the fate and tran | sport of solutes in po | orous media. Analytic |
| | numerical and experimental tools and tec | chniques will be used in this module. | | |
| | · | | | |
| Skills | | tudents will be exposed to analytical, experim | | |
| | · | excellent opportunity to improve their skills or | n multiple fronts whic | h will be useful in th |
| | future career. | | | |
| Personal Competence | | | | |
| Social Competence | Teamwork & problem solving | | | |
| Autonomy | The students will be involved in writing | g individual reports and presentation. This w | will contribute to the | e students' ability a |
| | willingness to work independently and re- | sponsibly. | | |
| Workload in Hours | Independent Study Time 96, Study Time | in Lecture 84 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Subject theoretical and practical work | | | |
| Examination duration and | Report | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structura | al Engineering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechi | nical Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Coastal E | Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Water an | nd Traffic: Elective Compulsory | | |
| | Civil Engineering: Specialisation Computa | tional Engineering: Elective Compulsory | | |
| | Chemical and Bioprocess Engineering: Te | chnical Complementary Course: Elective Com | pulsory | |
| | Environmental Engineering: Core Qualific | ation: Compulsory | | |
| | Process Engineering: Specialisation Enviro | onmental Process Engineering: Elective Comp | ulsory | |
| | Process Engineering: Specialisation Proce | ss Engineering: Elective Compulsory | | |
| | Water and Environmental Engineering: Sp | pecialisation Water: Compulsory | | |
| | Water and Environmental Engineering: Sp | acciplication Environment: Elective Compulsor | | |

| Course L2731: Modeling of S | ubsurface Processes |
|-----------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 3 |
| CP | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Dr. Milad Aminzadeh |
| Language | EN |
| Cycle | WiSe |
| Content | Basic usage and background of chosen computer software to calculate flow and transport in the saturated and unsaturated zone and to analyze field data like pumping test data |
| Literature | |

| Course L2728: Subsurface So | olute Transport |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Nima Shokri |
| Language | EN |
| Cycle | WiSe |
| Content | Basic physical properties of soil: Definition and quantification; Liquid flow in soils (Darcy's law); Solute transport in soils; Practical analysis to measure dispersion coefficient in soil under different boundary conditions; Advanced topics (e.g. Application of Artificial Intelligence to predict soil salinization) |
| Literature | - Environmental Soil Physics, by Daniel Hillel - Soil Physics, Sixth Edition, by William A. Jury and Robert Horton |

| Course L2729: Subsurface So | urse L2729: Subsurface Solute Transport | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Hannes Nevermann | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Module M1845: Thin- | walled structures | | | |
|--------------------------------|---|---|--------------------|----------------------|
| | walled structures | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Thin-walled structures (L1199) | | Lecture | 2 | 3 |
| Thin-walled structures (L3045) | | Recitation Section (large) | 2 | 3 |
| Module Responsible | Prof. Bastian Oesterle | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | Structural Analysis I | | | |
| | Structural Analysis II | | | |
| | Finite Element Methods | | | |
| Educational Objectives | After taking part successfully, students have reac | hed the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After successful completion of this module, the | students can express the basic aspects of | the load-carryin | g behaviour of thin |
| | walled structures. | | | |
| Skille | After successful completion of this module, the s | tudents will be able to predict load-carrying | n behaviour of th | ain-walled structure |
| 5/11/3 | using appropriate analytical and coputational met | | | ini-walled scructure |
| | | nous. | | |
| Personal Competence | | | | |
| Social Competence | Students can | | | |
| | participate in subject-specific and interdisci | plinary discussions, | | |
| | defend their own work results in front of other | ners | | |
| | promote the scientific development of colle | aques | | |
| | Furthermore, they can give and accept prot | • | | |
| | | | | |
| Autonomy | Students are able to gain knowledge of the subject | | | |
| | they are able to structure the solution process for | problems in the area of modelling and analy | sis of thin-walled | d structures. |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Engineeri | ng: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Eng | ineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Computational Er | ngineering: Compulsory | | |
| | Civil Engineering: Specialisation Structural Engine | ering: Elective Compulsory | | |
| | Theoretical Mechanical Engineering: Specialisation | n Simulation Technology: Elective Compulsor | ry | |

| Тур | Lecture |
|-------------------|---|
| Hrs/wk | |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| | Prof. Bastian Oesterle |
| Language | DE |
| Cycle | SoSe |
| Content | Plates loaded in-plane |
| | Governing equations (equilibrium, kinematics, constitutive law) |
| | Differential equation |
| | Airy stress function |
| | Plane stress / plane strain |
| | Structural behaviour of plates loaded in-plane |
| | finite elements for plates loaded in-plane, modelling apsects, interpretation and critical assessment of results |
| | Plates in bending |
| | Governing equations (equilibrium, kinematics, constitutive law) |
| | Differential equation |
| | Navier solution / Fourier series expansion |
| | Approximation procedures |
| | Circular and rectangular plates |
| | Structural behaviour of plates in bending |
| | • finite elements for plates in bending, modelling apsects, interpretation and critical assessment of results |
| | Shells |
| | Phenomenona of the structural behaviour of shells |
| | Membrane and bending theory |
| | |
| | Equilibrium equations of shells of revolution Stress resultants and deformations of the spherical shell, the half spherical shell, and the cylindrical shell |
| | Stress resultants and deformations of the spherical shell, the nan spherical shell, and the cylindrical shell finite elements for shells |
| | Stability problems (overview) |
| | |
| | Plate buckling |
| | Shell buckling |
| | |
| Literature | Vorlesungsmanuskript |
| | Basar, Y.: Krätzig, W.B. (1985): Mechanik der Flächentragwerke. Vieweg-Verlag, Braunschweig, Wiesbaden |
| | Girkmann, K. (1963): Flächentragwerke, Springer Verlag, Wien, 1963, unveränderter Nachdruck 1986 |
| | • Zienkiewicz, O.C. (1977): The Finite Element Method in Enginieering Science. McGraw-Hill, London |
| | |

| Course L3045: Thin-walled st | urse L3045: Thin-walled structures | |
|------------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| CP | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Bastian Oesterle | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|-------------------------------------|--|------------------------------------|------------------|---------------------|
| Title | | Түр | Hrs/wk | СР |
| Hydraulic Models (L0813) | | Project-/problem-based Learning | 1 | 1 |
| Modelling of Waves (L0812) | | Project-/problem-based Learning | 1 | 1 |
| Modelling of Flow in Rivers and Est | iaries (L0810) | Lecture | 3 | 4 |
| Module Responsible | Prof. Peter Fröhle | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Coastal Hydraulic Engineering I | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the follo | wing learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to define in detail the basic processes that are related to the modelling of flows in hydraulic engineerin | | | |
| | Besides, they can describe the basic aspects of numerical m | odelling and actual numerical mod | lels for the sir | nulation of flows a |
| | waves. | | | |
| Skills | Students are able to apply hydrodynamic-numerical models to | practical hydraulic engineering ta | sks | |
| 01110 | | | | |
| Personal Competence | | | | |
| Social Competence | The students are able to deploy their gained knowledge in sir | nple applied problems. Additionaly | , they will be | able to work in tea |
| | with others. | | | |
| , | The students will be able to independently extend their knowledge and apply it to new problems. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | The duration of the examination is 3 hours. The examination | on includes tasks with respect to | the general u | understanding of t |
| scale | lecture contents and calculations tasks. | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Elective Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Ele | | | |
| | Civil Engineering: Specialisation Coastal Engineering: Elective | 1 5 | | |
| | Civil Engineering: Specialisation Computational Engineering: O | Compulsory | | |

| Course L0813: Hydraulic Models | | |
|--------------------------------|--|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Peter Fröhle | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | Fundamentals of hydraulic models Model laws Pi theorem of Buckingham Practical examples of hydraulic models | |
| Literature | Strobl, Zunic: Wasserbau, Kap. 11 Hydraulische Modelle, Springer | |

| Course L0812: Modelling of | Waves | | |
|----------------------------|--|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | ependent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Peter Fröhle | | |
| Language | DE/EN | | |
| Cycle | SoSe | | |
| Content | Waves, interactions with shallow water and constructions Wave theories Sea state and surges Development of waves Wave spectra Modelling of Waves / phase averaged and phase resolved models Application of a phase averaged model for wave prediction (SWAN) Application of phase resolved wave models (Mike) | | |
| Literature | Vorlesungsumdruck | | |

| Course L0810: Modelling of I | |
|------------------------------|--|
| | Lecture |
| Hrs/wk | |
| СР | 4 |
| | Independent Study Time 78, Study Time in Lecture 42 |
| | Prof. Edgar Nehlsen, Prof. Peter Fröhle |
| Language | |
| Cycle | SoSe Introduction to numerical flow modelling |
| | Processes affecting tht flow Examples and applications of numerical models Procedure of numerical modelling Model concept Basic equations of hydrodynamics Saint-Venant equations Euler Equations Navier-Stokes equations Reynolds-averaged Navier-Stokes equations Shallow water equations |
| | Solving schemes Numerical discretization Solution algorithms Convergence |
| Literature | Vorlesungsskript |
| | Bund der Ingenieure für Wasserwirtschaft, Abfallwirtschaft und Kulturbau (1997): Hydraulische Berechnung von naturnaher Fließgewässern. Düsseldorf: BWK (BWK-Merkblatt). Chow, Ven-te (1959): Open-channel Hydraulics. New York usw.: McGraw-Hill (McGraw-Hill Civil Engineering Series). Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (DWA); DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische Modelle, DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische (2019a): Merkblatt DWA-M 543-2 Geodaten in der Fließgewässermodellierung Teil 1: Geodaten in der Fließgewässermodellierung. Februar 2019. Hennef: Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall (DWA-Regelwerk, 543-1). |
| | Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (DWA); DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische Modelle, DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische (2019b): Merkblatt DWA-M 543-2 Geodaten in der Fließgewässermodellierung Teil 2: Bedarfsgerechte Datenerfassung und -aufbereitung. Februar 2019. Hennef: Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall (DWA-Regelwerk, 543-2). |
| | Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (DWA); DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische Modelle, DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische (2019c): Merkblatt DWA-M 543-3 Geodaten in de Fließgewässermodellierung - Teil 3: Aspekte der Strömungsmodellierung und Fallbeispiele. Februar 2019. Hennef: Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall (DWA-Regelwerk, 543-3). |
| | Hervouet, Jean-Michel (2007): Hydrodynamics of free surface flows. Modelling with the finite element method. Chichester: Wiley Online verfügbar unter http://www.loc.gov/catdir/enhancements/fy0741/2007296953-b.html. |
| | IAHR (2015): Professional Specifications for Physical and Numerical Studies in Environmental Hydraulics. In: Hydrolink (3/2015), S 90-92. |
| | Olsen, Nils Reidar B. (2012): Numerical Modelling and Hydraulics. 3. Aufl. Department of Hydraulic and Environmental Engineering The Norwegian University of Science and Technology. |
| | Szymkiewicz, Romuald (2010): Numerical modeling in open channel hydraulics. Dordrecht: Springer (Water science and technology library, 83). |
| | van Waveren, Harold (1999-): Good modelling practice handbook. [Utrecht], Lelystad, Den Haag: STOWA; Rijkswaterstaat-RIZA SDU, afd. SEO/RIZA [etc. distr.] (Nota, nr. 99.036). |
| | Zielke, Werner (Hg.) (1999): Numerische Modelle von Flüssen, Seen und Küstengewässern. Deutscher Verband für Wasserwirtschaft und Kulturbau. Bonn: Wirtschafts- und VerlGes. Gas und Wasser (Schriftenreihe des Deutschen Verbandes für Wasserwirtschaft und Kulturbau, 127). |

| Courses | | | | |
|---|---|--|--------|----|
| Title | | Тур | Hrs/wk | СР |
| Digital Twinning in Civil Engineering (L3136) | | Lecture | 2 | 2 |
| Digital Twinning in Civil Engineerin | g (L3137) | Seminar | 2 | 4 |
| Module Responsible | Alexander Chmelnizkij | | | |
| Admission Requirements | None | | | |
| Recommended Previous | | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students h | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | | | | |
| Skills | | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | | | | |
| Workload in Hours | Independent Study Time 124, Study Time | e in Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Presentation | | | |
| Examination duration and | 20 min presentation and 5 pages handou | t | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Compute | ational Engineering: Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Coastal I | Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Geotech | nical Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Structura | al Engineering: Elective Compulsory | | |

| Course L3136: Digital Twinning in Civil Engineering | | |
|---|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Alexander Chmelnizkij, Prof. Bastian Oesterle, Prof. Kay Smarsly | |
| Language | DE | |
| Cycle | SoSe | |
| Content | | |
| Literature | | |

| Course L3137: Digital Twinn | ourse L3137: Digital Twinning in Civil Engineering | | |
|-----------------------------|--|--|--|
| Тур | Seminar | | |
| Hrs/wk | 2 | | |
| СР | 4 | | |
| Workload in Hours | pendent Study Time 92, Study Time in Lecture 28 | | |
| Lecturer | Alexander Chmelnizkij, Prof. Bastian Oesterle, Prof. Kay Smarsly | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | | |
|--|--|--|-------------------|----------------------|--|
| Title | | Тур | Hrs/wk | СР | |
| Marine Geotechnics (L0548) | | Lecture | 1 | 2 | |
| Marine Geotechnics (L0549) Steel Structures in Foundation and | Hydraulic Engineering (L1146) | Recitation Section (large) Lecture | 2 | 2 | |
| Module Responsible | | 2000.0 | - | - | |
| Admission Requirements | | | | | |
| | Complete modules: Geotechnics I-III, Math | ematics I-III | | | |
| Knowledge | • | | | | |
| | Courses: Soil laboratory course | | | | |
| Educational Objectives | After taking part successfully, students ha | ve reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | The students get a deeper knowledge of steel and ground engineering as well as constructions knowledge concerning quay wa | | | | |
| | Furthermore, the students get all the nece | essary knowledge to design singular construction e | elements for shee | et pile walls and th | |
| | know how to choose the right construction elements depending on the influencing conditions. | | | | |
| Cl://l- | Furthermore, the shudents are able to div | | | | |
| SKIIIS | Furthermore, the students are able to dimension sheet pile wall construction regarding all construction elements, to choose the | | | | |
| | suitable construction elements with respect to the influencing conditions, to design all kinds of sheet pile walls walls and combined sheet pile walls) and to dimension all construction elements and connections. | | | | |
| | waits and combined sneet pile waits) and t | o dimension all construction elements and connect | 10115. | | |
| Personal Competence | | | | | |
| Social Competence | | | | | |
| Autonomy | Students are able to assess their own stree | ngths and weaknesses and organize their time and | learning manage | ement based on th | |
| 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 | Civil Engineering: Specialisation Geotechni | ical Engineering: Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Structural Engineering: Elective Compulsory | | | | |
| | Civil Engineering: Specialisation Coastal Engineering: Compulsory | | | | |
| | Civil Engineering: Specialisation Computat | ional Engineering: Elective Compulsory | | | |
| | | | | | |

| Course L0548: Marine Geote | chnics | | |
|----------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 1 | | |
| СР | | | |
| Workload in Hours | ependent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Prof. Jürgen Grabe | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Geotechnical investigation an description of the seabed Foundations of Offshore-Constructions cCliff erosion Sea dikes Port structures Flood protection structures | | |
| Literature | EAK (2002): Empfehlungen für Küstenschutzbauwerke EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke Poulos H.G. (1988): Marine Geotechnics. Unwin Hyman, London Wagner P. (1990): Meerestechnik: Eine Einführung für Bauingenieure. Ernst & Sohn, Berlin | | |

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| Course L0549: Marine Geote | rse L0549: Marine Geotechnics | | |
|----------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Jürgen Grabe | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Course L1146: Steel Structur | Course L1146: Steel Structures in Foundation and Hydraulic Engineering | | |
|------------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Frank Feindt | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Design of a sheet pile wall, design of a combined sheet pile wall, piles, walings, connections, fatigue | | |
| Literature | EAU 2012, EA-Pfähle, EAB | | |

| Courses | | | | | |
|------------------------------------|---|---|--------|----|--|
| ſitle | | Тур | Hrs/wk | СР | |
| Steel Construction Project (L1206) | | Project Seminar | 4 | 6 | |
| Module Responsible | Prof. Marcus Rutner | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Steel and Composite Structures | | | | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students hav | e reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | Students are able to prepare a part of the v | whole project and explain it to the others. | | | |
| Skills | Students can produce sketches and calculations of their part of the project. They are able to adjust their work in reaction | | | | |
| | changing conditions resulting from other pa | articipants of the project. | | | |
| Personal Competence | | | | | |
| Social Competence | Students can present their results to other members of the group. | | | | |
| | They have the ability to work for a broad agreement with respect to intergroup dependencies. | | | | |
| | They can distribute and process tasks indep | pendently. | | | |
| Autonomy | Students can handle their part of the project | t on their own resposibility- | | | |
| Workload in Hours | Independent Study Time 124, Study Time i | n Lecture 56 | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Written elaboration | | | | |
| Examination duration and | approx. 15-20 pages (without appendix) | | | | |
| scale | | | | | |
| Assignment for the | Civil Engineering: Specialisation Geotechnic | al Engineering: Elective Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Coastal En | gineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Structural | Engineering: Compulsory | | | |
| | Civil Engineering: Specialisation Computation | onal Engineering: Elective Compulsory | | | |

| Course L1206: Steel Constru | Course L1206: Steel Construction Project | | |
|-----------------------------|---|--|--|
| Тур | Project Seminar | | |
| Hrs/wk | 4 | | |
| СР | 6 | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | |
| Lecturer | Prof. Marcus Rutner | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Design of a big construction project (i.e skyscraper, large bridge, roof of a stadiuim) in small groups | | |
| Literature | Wird je nach Projekt individuell angegeben. | | |

| Courses | | | | | |
|--|--|--|----------------------|--------------------|--|
| Title | | Тур | Hrs/wk | СР | |
| Numerical Algorithms in Structural Mechanics (L0284) | | Lecture | 2 | 3 | |
| Numerical Algorithms in Structural | Mechanics (L0285) | Recitation Section (small) | 2 | 3 | |
| Module Responsible | Prof. Alexander Düster | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Knowledge of partial differential equations | is recommended. | | | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students ha | ve reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | Students are able to | | | | |
| | + give an overview of the standard algorit | hms that are used in finite element programs. | | | |
| | + explain the structure and algorithm of fi | nite element programs. | | | |
| | + specify problems of numerical algorithm | ns, to identify them in a given situation and to | explain their mather | matical and comput | |
| | science background. | | | | |
| Skills | Students are able to | | | | |
| Skiis | + construct algorithms for given numerical methods. | | | | |
| | + select for a given problem of structural mechanics a suitable algorithm. | | | | |
| | + apply numerical algorithms to solve problems of structural mechanics. | | | | |
| | + implement algorithms in a high-level programming languate (here C++). | | | | |
| | + critically judge and verfiy numerical alg | | | | |
| | | | | | |
| Personal Competence | | | | | |
| Social Competence | Students are able to | | | | |
| | + solve problems in heterogeneous group | | | | |
| | + present and discuss their results in from | | | | |
| | + give and accept professional constructiv | /e criticism. | | | |
| Autonomy | Students are able to | | | | |
| | + assess their knowledge by means of exe | ercises and E-Learning. | | | |
| | + acquaint themselves with the necessary knowledge to solve research oriented tasks. | | | | |
| | + to transform the acquired knowledge to similar problems. | | | | |
| | | | | | |
| Workload in Hours | Independent Study Time 124, Study Time | in Lecture 56 | | | |
| Credit points | | | | | |
| Course achievement | | | | | |
| Examination | | | | | |
| Examination duration and | | | | | |
| scale | | | | | |
| | Civil Engineering: Specialisation Computat | ional Engineering: Elective Compulsory | | | |
| Following Curricula | Materials Science: Specialisation Modeling | | | | |
| string curriculu | Naval Architecture and Ocean Engineering | | | | |
| | Technomathematics: Specialisation III. End | | | | |
| | Theoretical Mechanical Engineering: Speci | | | | |

| Course L0284: Numerical Alg | orithms in Structural Mechanics |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Alexander Düster |
| Language | EN |
| Cycle | SoSe |
| Content | 1. Motivation |
| | 2. Basics of C++ |
| | 3. Numerical integration |
| | 4. Solution of nonlinear problems |
| | 5. Solution of linear equation systems |
| | 6. Verification of numerical algorithms |
| | 7. Selected algorithms and data structures of a finite element code |
| Literature | [1] D. Yang, C++ and object-oriented numeric computing, Springer, 2001. |
| | [2] KJ. Bathe, Finite-Elemente-Methoden, Springer, 2002. |

| Course L0285: Numerical Alg | urse L0285: Numerical Algorithms in Structural Mechanics | | |
|-----------------------------|--|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Alexander Düster | | |
| Language | EN | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | | |
|--|--|---|---------------------|---------------------|--|
| Title | (10000) | Тур | Hrs/wk | СР | |
| Computational Structural Dynamics Computational Structural Dynamics | | Lecture Recitation Section (small) | 3 1 | 4 | |
| | | Necleation Section (smail) | Ŧ | 2 | |
| Module Responsible | | | | | |
| Admission Requirements | | and the second | | | |
| | Knowledge of partial differential equation | ins is recommended. | | | |
| Knowledge | | | | | |
| | After taking part successfully, students | have reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | Students are able to | | | | |
| | | l procedures for problems of structural dynamics. | | | |
| | | nt programs to solve problems of structural dynam | | | |
| | | ructural dynamics, to identify them in a given situ | lation and to expla | in their mathematic | |
| | and mechanical background. | | | | |
| Skills | Students are able to | | | | |
| | + model problems of structural dynamic | 25. | | | |
| | + select a suitable solution procedure for a given problem of structural dynamics. | | | | |
| | + apply computational procedures to solve problems of structural dynamics. | | | | |
| | + verify and critically judge results of co | omputational structural dynamics. | | | |
| | | | | | |
| Personal Competence | | | | | |
| Social Competence | Students are able to | | | | |
| | + solve problems in heterogeneous grou | | | | |
| | + present and discuss their results in front of others. | | | | |
| | + give and accept professional construct | tive criticism. | | | |
| Autonomy | Students are able to | | | | |
| | + assess their knowledge by means of e | exercises and E-Learning. | | | |
| | + acquaint themselves with the necessa | ary knowledge to solve research oriented tasks. | | | |
| | $\mbox{+}$ to transform the acquired knowledge | to similar problems. | | | |
| | | | | | |
| Workload in Hours | Independent Study Time 124, Study Tim | ne in Lecture 56 | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and | 2h | | - | - | |
| scale | | | | | |
| Assignment for the | Civil Engineering: Specialisation Comput | tational Engineering: Elective Compulsory | | | |
| Following Curricula | International Management and Engineer | ring: Specialisation II. Mechatronics: Elective Comp | ulsory | | |
| - | Materials Science: Specialisation Modeli | ng: Elective Compulsory | | | |
| | Mechatronics: Technical Complementary | y Course: Elective Compulsory | | | |
| | Naval Architecture and Ocean Engineeri | ng: Core Qualification: Elective Compulsory | | | |
| | Theoretical Mechanical Engineering: Spe | ecialisation Simulation Technology: Elective Comp | ilsory | | |

| Course L0282: Computationa | al Structural Dynamics |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Alexander Düster |
| Language | EN |
| Cycle | SoSe |
| Content | 1. Motivation |
| | 2. Basics of dynamics |
| | 3. Time integration methods |
| | 4. Modal analysis |
| | 5. Fourier transform |
| | 6. Applications |
| Literature | [1] K. L. Datha, Finite Flamante Mathadan, Envinger, 2002 |
| Literature | [1] KJ. Bathe, Finite-Elemente-Methoden, Springer, 2002. |
| | [2] J.L. Humar, Dynamics of Structures, Taylor & Francis, 2012. |

| Course L0283: Computationa | urse L0283: Computational Structural Dynamics | | |
|----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 1 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Prof. Alexander Düster | | |
| Language | EN | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Module M0604: High- | Order FEM | | | | | |
|--|-----------------------|---------------------------------|---------------------------------------|------------------|--------------------|-------------------|
| Courses | | | | | | |
| Title | | | Тур | | Hrs/wk | СР |
| High-Order FEM (L0280) High-Order FEM (L0281) | | | Lecture Recitation Se | ection (large) | 3 | 4 2 |
| Module Responsible | Prof. Alexander Düst | ter | | (| _ | |
| Admission Requirements | None | | | | | |
| Recommended Previous | | l differential equations i | is recommended | | | |
| Knowledge | Knowledge of partia | | is recommended. | | | |
| Educational Objectives | After taking part su | cessfully students hav | e reached the following learning r | esults | | |
| Professional Competence | , neer canny pare bat | .cessiany, stadents nav | | courto | | |
| | Students are able to | 1 | | | | |
| Kilowicage | | |) finite element procedures. | | | |
| | - | r finite element procedu | | | | |
| | | | edures, to identify them in a give | ven situation an | d to explain the | ir mathematical a |
| | mechanical backgro | und. | | | | |
| Skills | Students are able to |) | | | | |
| | | | ems of structural mechanics. | | | |
| | | | echanics a suitable finite element | procedure. | | |
| | _ | ' sults of high-order finite | | | | |
| | | | ite elements to new problems. | | | |
| Personal Competence | | | | | | |
| Social Competence | Students are able to |) | | | | |
| | + solve problems in | heterogeneous groups | | | | |
| | + present and discu | iss their results in front | of others. | | | |
| | + give and accept p | professional constructive | e criticism. | | | |
| | | | | | | |
| Autonomy | Students are able to | | | | | |
| | | ledge by means of exer | | | | |
| | | | knowledge to solve research orien | ited tasks. | | |
| | + to transform the a | acquired knowledge to s | similar problems. | | | |
| Workload in Hours | Independent Study . | Time 124, Study Time ii | a Lecture 56 | | | |
| Credit points | | | | | | |
| Course achievement | Compulsory Bonus | Form | Description | | | |
| | No 10 % | Presentation | Forschendes Lernen | | | |
| Examination | Written exam | | | | | |
| Examination duration and | 120 min | | | | | |
| scale | | | | | | |
| Assignment for the | Civil Engineering: Sp | pecialisation Computation | onal Engineering: Elective Compul | sory | | |
| Following Curricula | International Manag | ement and Engineering | : Specialisation II. Product Develop | pment and Produ | ction: Elective Co | ompulsory |
| | Materials Science: S | pecialisation Modeling: | Elective Compulsory | | | |
| | Mechanical Enginee | ring and Management: | Specialisation Product Developme | nt and Productio | n: Elective Comp | ulsory |
| | Mechatronics: Techr | nical Complementary Co | ourse: Elective Compulsory | | | |
| | Product Development | nt, Materials and Produc | ction: Core Qualification: Elective (| Compulsory | | |
| | Naval Architecture a | and Ocean Engineering: | Core Qualification: Elective Comp | ulsory | | |
| | | | neering Science: Elective Compute | sory | | |
| | Theoretical Mechani | cal Engineering: Core Q | ualification: Elective Compulsory | | | |

| Course L0280: High-Order FE | :M |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Alexander Düster |
| Language | EN |
| Cycle | SoSe |
| Content | 1. Introduction |
| | 2. Motivation |
| | 3. Hierarchic shape functions |
| | 4. Mapping functions |
| | 5. Computation of element matrices, assembly, constraint enforcement and solution |
| | 6. Convergence characteristics |
| | 7. Mechanical models and finite elements for thin-walled structures |
| | 8. Computation of thin-walled structures |
| | 9. Error estimation and hp-adaptivity |
| | 10. High-order fictitious domain methods |
| | |
| | |
| Literature | [1] Alexander Düster, High-Order FEM, Lecture Notes, Technische Universität Hamburg-Harburg, 164 pages, 2014 |
| | [2] Barna Szabo, Ivo Babuska, Introduction to Finite Element Analysis - Formulation, Verification and Validation, John Wiley & Sons, |
| | 2011 |
| | |
| | |

| Course L0281: High-Order FE | EM |
|-----------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Alexander Düster |
| Language | EN |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Structural Dynamics (L1202)LStructural Dynamics (L1203)RFracture mechanics and fatigue in steel structures (L0564)L | yp ecture ecitation Section (large) ecture ecitation Section (large) | Hrs/wk 2 2 1 | СР 2 |
|--|--|------------------------------|-------------------|
| Structural Dynamics (L1202) L Structural Dynamics (L1203) R Fracture mechanics and fatigue in steel structures (L0564) L Fracture mechanics and fatigue in steel structures (L0565) R Module Responsible Prof. Bastian Oesterle Admission Requirements None Recommended Previous Knowledge of linear structural analysis of statically determinate Differential equations I Educational Objectives After taking part successfully, students have reached the following Professional Competence Knowledge Knowledge After successful completion of this module, the student can explirespective methods. Skills After successful completion of this module, the students will b dynamics loading using the appropriate computational approaches Personal Competence Kills | ecture ecitation Section (large) ecture | 2 2 | |
| Structural Dynamics (L1203) R Fracture mechanics and fatigue in steel structures (L0564) L Fracture mechanics and fatigue in steel structures (L0565) R Module Responsible Prof. Bastian Oesterle Admission Requirements None Recommended Previous Knowledge of linear structural analysis of statically determinate Differential equations I Educational Objectives After taking part successfully, students have reached the following Professional Competence Knowledge Knowledge After successful completion of this module, the student can explirespective methods. Skills After successful completion of this module, the students will b dynamics loading using the appropriate computational approaches Personal Competence Viramics loading using the appropriate computational approaches | ecitation Section (large) ecture | 2 | 2 |
| Fracture mechanics and fatigue in steel structures (L0564) L Fracture mechanics and fatigue in steel structures (L0565) R Module Responsible Prof. Bastian Oesterle Admission Requirements None Recommended Previous Knowledge of linear structural analysis of statically determinate Differential equations I Educational Objectives After taking part successfully, students have reached the following Professional Competence Knowledge Knowledge After successful completion of this module, the student can explirespective methods. Skills After successful completion of this module, the students will be dynamics loading using the appropriate computational approaches Personal Competence After successful completion of this module, the students will be dynamics loading using the appropriate computational approaches | ecture | | |
| Fracture mechanics and fatigue in steel structures (L0565) R Module Responsible Prof. Bastian Oesterle Admission Requirements None Recommended Previous Knowledge of linear structural analysis of statically determinate Differential equations I Differential equations I Educational Objectives After taking part successfully, students have reached the following Professional Competence Knowledge Knowledge After successful completion of this module, the student can expline respective methods. Skills After successful completion of this module, the students will be dynamics loading using the appropriate computational approaches Personal Competence After successful completion of this module, the students will be dynamics loading using the appropriate computational approaches | | 1 | 2 |
| Module Responsible Prof. Bastian Oesterle Admission Requirements None Recommended Previous Knowledge of linear structural analysis of statically determinate Differential equations I Educational Objectives After taking part successfully, students have reached the following Professional Competence After successful completion of this module, the student can explare respective methods. Skills After successful completion of this module, the students will be dynamics loading using the appropriate computational approaches Personal Competence After successful completion of this module, the students will be dynamics loading using the appropriate computational approaches | ecitation Section (large) | | 1 |
| Admission Requirements None Recommended Previous Knowledge of linear structural analysis of statically determinate Differential equations I Differential equations I Educational Objectives After taking part successfully, students have reached the following Professional Competence Knowledge Knowledge After successful completion of this module, the student can expline Skills After successful completion of this module, the students will be dynamics loading using the appropriate computational approaches Personal Competence Image: Skills | | 1 | 1 |
| Recommended Previous Knowledge of linear structural analysis of statically determinate Knowledge Differential equations I Educational Objectives After taking part successfully, students have reached the following Professional Competence Knowledge Knowledge After successful completion of this module, the student can expline respective methods. Skills After successful completion of this module, the students will be dynamics loading using the appropriate computational approaches Personal Competence Image: Skills | | | |
| Knowledge Differential equations I Educational Objectives After taking part successfully, students have reached the following Professional Competence After successful completion of this module, the student can expli- respective methods. Skills After successful completion of this module, the students will b dynamics loading using the appropriate computational approaches | | | |
| Educational Objectives After taking part successfully, students have reached the following Professional Competence After successful completion of this module, the student can explicitly respective methods. Skills After successful completion of this module, the students will b dynamics loading using the appropriate computational approaches Personal Competence Image: Competence | and indeterminate structu | ires; Mechanics | I/II, Mathematics |
| Professional Competence After successful completion of this module, the student can expline respective methods. Skills After successful completion of this module, the students will be dynamics loading using the appropriate computational approaches Personal Competence Personal Competence | | | |
| Professional Competence After successful completion of this module, the student can expline respective methods. Skills After successful completion of this module, the students will be dynamics loading using the appropriate computational approaches Personal Competence Personal Competence | learning results | | |
| Knowledge After successful completion of this module, the student can expl respective methods. Skills After successful completion of this module, the students will b dynamics loading using the appropriate computational approaches Personal Competence | icaning results | | |
| respective methods. Skills After successful completion of this module, the students will b dynamics loading using the appropriate computational approaches Personal Competence | ain the basic aspects of dy | namic effects o | n structures and |
| Skills After successful completion of this module, the students will b dynamics loading using the appropriate computational approaches | | | |
| participate in subject-specific and interdisciplinary discussiodefend their own work results in front of others | and methods. | ponse of materi | al and structures |
| promote the scientific development of colleagues | | | |
| Furthermore, they can give and accept professional constru- | ctive criticism | | |
| Autonomy Students are able to gain knowledge of the subject area from give | n and other sources and ar | nly it to new pr | oblems Furthermo |
| | Students are able to gain knowledge of the subject area from given and other sources and apply it to new problems. Furthermore they are able to structure the solution process for problems in the area of Structural Analysis. | | |
| they are able to structure the solution process for problems in the | area of Scructural Analysis. | | |
| Workload in Hours Independent Study Time 96, Study Time in Lecture 84 | | | |
| Credit points 6 | | | |
| Course achievement None | | | |
| Examination Written exam | | | |
| Examination duration and 150 min | | | |
| scale | | | |
| Assignment for the Civil Engineering: Specialisation Structural Engineering: Compulsor | у | | |
| Following Curricula Civil Engineering: Specialisation Geotechnical Engineering: Elective | - | | |
| Civil Engineering: Specialisation Coastal Engineering: Elective Com | | | |
| Civil Engineering: Specialisation Water and Traffic: Elective Compu | | | |
| Civil Engineering: Specialisation water and Trant. Elective Compu- Civil Engineering: Specialisation Computational Engineering: Electi | - | | |
| International Management and Engineering: Specialisation Computational Engineering: Electric | | ulcon | |

| Course L1202: Structural Dy | namics |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Bastian Oesterle |
| Language | DE |
| Cycle | SoSe |
| Content | mechanical background of dynamics harmonic vibrations, damped and undamped free and forced vibrations frequency and time domain modelling aspects principle of d'Alembert systems with multiple degrees of freedom consistent and lumped mass matrices finite elements for dynamics problems impact problems eigenvalue problems and modal analysis direct time integration schemes, transient analyses |
| Literature | Vorlesungsmanuskript Clough, R.W., Penzien, J.: Dynamics of Structures. 2. Aufl., McGraw-Hill, New York, 1993. |

| Course L1203: Structural Dy | ourse L1203: Structural Dynamics | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Bastian Oesterle | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Тур | Lecture |
|-------------------|---|
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Jürgen Priebe |
| Language | DE |
| Cycle | SoSe |
| Content | basics of fatigue stress and fatigue resistance and determination of fatigue strength, |
| | determination and use of S-N-curves and classification of notch effects, |
| | set up of determination of fatigue strength under dynamic load using the accumulation formula by Palmgren-Miner, |
| | set up of determination of fatigue strength in different examples, |
| | basics of construction and design regarding the problem of material fatigue, |
| | basics of linear elastic fracture mechanics under static and dynamic load, |
| | determination of lifetime of steel construction based on linear elastic fracture mechanics in different examples. |
| Literature | Seeßelberg, C.; Kranbahnen - Bemessung und konstruktive Gestaltung; 3. Auflage; Bauwerk-Verlag; Berlin 2009 |
| | • Kuhlmann, Dürr, Günther; Kranbahnen und Betriebsfestigkeit; in Stahlbau Kalender 2003; Verlag Ernst & Sohn; Berlin 200 |
| | Deutscher Stahlbau-Verband (Hrsg.); Stahlbau Handbuch Band 1 Teil B; 3. Auflage; Stahlbau-Verlagsgesellschaft; Köln 19 |
| | Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993 |
| | DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsre Bemessungsregeln für den Hochbau; 1993 |
| | • DIN V ENV 1993-6: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 6: Kranbahnen; 2001 |
| | • DIN-Fachbericht 126. Richtlinie zur Anwendung von DIN V ENV 1993-6; Nationales Anwendungsdokument (NAD); Berlin 20 |
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| Course L0565: Fracture mechanics and fatigue in steel structures | |
|--|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Jürgen Priebe |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Courses | | | | |
|--|---|---|----------------|----------------------|
| Title | | Тур | Hrs/wk | СР |
| Groundwater Modeling using Modfle | | Lecture | 1 | 1 |
| Groundwater Modeling using Modfle | | Recitation Section (small) | 2 | 2 3 |
| Modeling of Water Supply Network | | Project-/problem-based Learning | 2 | 3 |
| Module Responsible | • | | | |
| Admission Requirements Recommended Previous | | | | |
| Kecommended Previous Knowledge | Groundwater | | | |
| Knowledge | groundwater hydraulics and transport of substan | ces | | |
| | Pipe Systems | | | |
| | Knowledge on urban water infrastructures, in | particular drinking water systemsand u | ırban drainag | e systems includir |
| | special structures | | 5 | |
| | Hydraulics of drinking water supply systems and | sewer systems | | |
| | Basic knowledge on water management | | | |
| Educational Objectives | After taking part successfully, students have reached th | e following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are able to describe the modelling of grou | ndwater flow and transport as well as urb | an water infra | astructures. They c |
| | carry out systems analyses and can detect technical a | nd conceptual weak points within the sys | tems in case s | studies. Besides th |
| | are able to analyse interdependencies of hydraulic and | toxic phenomena in soil and water. | | |
| | | | | |
| | | | | |
| Skills | The students are able to construct and apply scientific | groundwater models indipendently. The | y can work o | n different scenario |
| | and can compare or assess different solutions for existing problems by application of selected software products. The students ar | | | |
| | able to use different software solutions (e.g. EPANET, E | PA-SWMM). | | |
| | | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| | Wird nicht vermittelt. | | | |
| | | | | |
| Autonomy | Wird nicht vermittelt. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | | | | |
| | 30 min | | | |
| scale | | | | |
| - | Civil Engineering: Specialisation Structural Engineering | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineer | | | |
| | Civil Engineering: Specialisation Coastal Engineering: E Civil Engineering: Specialisation Water and Traffic: Elec | | | |
| | Civil Engineering: Specialisation Water and Trainc: Elec Civil Engineering: Specialisation Computational Enginee | | | |
| | Water and Environmental Engineering: Specialisation E | | | |
| | Water and Environmental Engineering: Specialisation C | | | |
| | Water and Environmental Engineering: Specialisation W | | | |

| Course L0543: Groundwater | Course L0543: Groundwater Modeling using Modflow | | |
|---------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Sonja Götz | | |
| Language | DE/EN | | |
| Cycle | SoSe | | |
| Content | Introduction and application of the groundwater model MODFLOW (PMWIN); theoretical backround of the modell, students do work | | |
| | with the model PMWIN for practical case studies. | | |
| Literature | MODFLOW-Handbuch | | |
| | Chiang, Wen Hsien: PMWIN | | |
| | | | |

| Course L0544: Groundwater | urse L0544: Groundwater Modeling using Modflow | | |
|---------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Sonja Götz | | |
| Language | DE/EN | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Course L0875: Modeling of Water Supply Network | | |
|--|--|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Dr. Klaus Johannsen | |
| Language | DE | |
| Cycle | SoSe | |
| Content | | |
| Literature | Mutschmann/Stimmelmayr: Taschenbuch der Wasserversorgung, 16. Auflage. Springer Vieweg - Verlag. Wiesbaden 2014. | |

| Courses | | | | | |
|--|--|---|-----------------------------------|-----------------|-------------------|
| Title | | Тур | | Hrs/wk | СР |
| Applied Surface Hydrology (L0289) | | Lecture | | 2 | 2 |
| Applied Surface Hydrology (L1412) | | | oblem-based Learning | 1 | 2 |
| nteraction Water - Environment in | | Project-/pr | oblem-based Learning | 1 | 2 |
| Module Responsible | Prof. Peter Fröhle | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Fundamentals of Hydromechanics an | d Hydraulic Engineering: Hydraulic En | gineering I and Hydra | ulic Engineerii | ng II |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, studen | ts have reached the following learning | g results | | |
| Professional Competence | | | | | |
| Knowledge | The students are able to define the | pasic concepts of hydrology and wate | er management. They | are able to d | lescribe and qua |
| | the relevant processes of the hydrological | gical water cycle. Besides, the stude | nts know the main asp | ects of rainfa | ll-run-off-models |
| | are able to theoretically derive estab | ished reservoir / storage models and | a unit-hydrograph. | | |
| <i></i> | | | | | |
| Skills | The students are able to use the basic hydrological concepts and approaches and are able to theoretically derive establisher reservoir / storage models or a unit-hydrograph as the basis for rainfall-run-off-models. The student are able to explain the bas | | | | |
| | - | | | | |
| | | ogical and hydrodynamic values in n | | | |
| | assess these measurements. Further | more, they are able to apply a hydrolo | ogical model to basic h | iydrological pi | roblems. |
| Personal Competence | | | | | |
| Social Competence | The students are able to deploy their | gained knowledge in applied problem | ns of the hydrology and | d water mana | gement. Addition |
| | they will be able to work in team with | engineers of other disciplines. | | | |
| Autonomy | The students will be able to independ | ently extend their knowledge and app | oly it to new problems | | |
| | | | | | |
| Workload in Hours | Independent Study Time 124, Study | Time in Lecture 56 | | | |
| Credit points | 6 | | | | |
| | None | | | | |
| Course achievement | Written exam | | | | |
| Course achievement Examination | Whiteh exam | | | | |
| Examination | The duration of the examination is 90 | min. The examination includes tasks | with respect to the ge | eneral underst | anding of the lec |
| Examination Examination duration and | | min. The examination includes tasks | with respect to the ge | eneral underst | anding of the lec |
| Examination Examination duration and scale | The duration of the examination is 90 | | | eneral underst | anding of the lec |
| Examination Examination duration and scale Assignment for the | The duration of the examination is 90 contents and calculations tasks. | putational Engineering: Elective Comp | | eneral underst | anding of the lec |
| Examination Examination duration and scale Assignment for the | The duration of the examination is 90 contents and calculations tasks. Civil Engineering: Specialisation Com | putational Engineering: Elective Comp er and Traffic: Compulsory | | eneral underst | anding of the lec |
| Examination Examination duration and scale Assignment for the | The duration of the examination is 90 contents and calculations tasks. Civil Engineering: Specialisation Com Civil Engineering: Specialisation Wate Environmental Engineering: Core Qua | putational Engineering: Elective Comp er and Traffic: Compulsory | bulsory | | anding of the lec |
| Examination Examination duration and scale Assignment for the | The duration of the examination is 90 contents and calculations tasks. Civil Engineering: Specialisation Com Civil Engineering: Specialisation Wate Environmental Engineering: Core Qua Joint European Master in Environmen | putational Engineering: Elective Comp er and Traffic: Compulsory Ilification: Elective Compulsory | oulsory Core Qualification: Co | | anding of the lec |
| Examination Examination duration and scale Assignment for the | The duration of the examination is 90 contents and calculations tasks. Civil Engineering: Specialisation Com Civil Engineering: Specialisation Watt Environmental Engineering: Core Qua Joint European Master in Environmen Water and Environmental Engineerin | putational Engineering: Elective Comp er and Traffic: Compulsory Ilification: Elective Compulsory cal Studies - Cities and Sustainability: | Core Qualification: Corulation | | anding of the lec |

| Course L0289: Applied Surfa | Course L0289: Applied Surface Hydrology | | |
|-----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Peter Fröhle | | |
| Language | DE/EN | | |
| Cycle | SoSe | | |
| Content | Basics of hydrology: Hydrological cycle Data acquisition Data analyses and statistical assessment Statistics of extremes | | |
| | Regionalization methods for hydrological values Rainfall-run-off modelling on the basis of a unit hydrograph conceps Application of rainfall-run-off models on the basis of Kalypso-Hydrology which is an OpenSource Software Tool. | | |
| Literature | http://de.wikipedia.org/wiki/Kalypso_(Software) http://kalypso.bjoernsen.de/ http://sourceforge.net/projects/kalypso/ | | |

| Course L1412: Applied Surfa | irse L1412: Applied Surface Hydrology | | |
|-----------------------------|---|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 1 | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Prof. Peter Fröhle | | |
| Language | DE/EN | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Course L0295: Interaction W | ourse L0295: Interaction Water - Environment in Fluvial Areas | | |
|-----------------------------|--|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 1 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Prof. Peter Fröhle | | |
| Language | DE/EN | | |
| Cycle | SoSe | | |
| Content | A problem based learning course. The problem will be solved by the students more or less self-contained. The topics will be introduced and elaborated over the semester. | | |
| Literature | - | | |

| Courses | | | | | |
|------------------------------------|---|--|-------------------|------------------|--|
| Title | | Тур | Hrs/wk | СР | |
| Design of Prestressed Structures a | nd Concreet Bridges (L0603) | Lecture | 3 | 4 | |
| Design of Prestressed Structures a | nd Concreet Bridges (L0604) | Recitation Section (large) | 2 | 2 | |
| Module Responsible | NN | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Detailed knowledge on the design of concrete structures. | | | | |
| Knowledge | Madulaa, Dainfanaad Cananata Churchunaa I | U. Chrystered Analysis I. U. Mashaning I. U. Canar | | | |
| | Modules: Reinforced Concrete Structures I+II, Structural Analysis I+II, Mechanics I+II, Concrete Structures | | | | |
| Educational Objectives | After taking part successfully, students ha | ve reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | The students know the main bridge types | s, their applications and the various loads. They | can explain the b | asic design meth | |
| | They can explain the design of a prestressed bridge. | | | | |
| <i>CL 11</i> | | | | | |
| SKIIIS | The students are able to design reinforced | f or prestressed concrete bridges. | | | |
| Personal Competence | | | | | |
| Social Competence | The students can design in teamwork a rea | al concrete bridge. | | | |
| 4 | The shudents are able to design a super- | | | | |
| Αυτοποτηγ | The students are able to design a prestres | sed concrete bridge and discuss the problems and | results with othe | r students. | |
| Workload in Hours | Independent Study Time 110, Study Time | in Lecture 70 | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and | 180 minutes | | | | |
| scale | | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural | Engineering: Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechni | ical Engineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Coastal Er | ngineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Computat | ional Engineering: Elective Compulsory | | | |
| | International Management and Engineering | | | | |

| Course L0603: Design of Pre | stressed Structures and Concreet Bridges |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | NN |
| Language | DE |
| Cycle | SoSe |
| Content | prestressed structures |
| | basis of prestressed structures, field of application differences between reinforced and prestressed concrete structures history of prestressing construction materials: concrete, tendons, ducts, anchorage systems construction: prestressing methods prestressing forces and member forces (friction, elongation) tendon layout time dependant prestressing losses design of prestressed structures design of anchorage region non-bonded prestressing prestressed flat slabs |
| | Concrete bridges history of bridges design of bridges loads on bridges loads on bridges member forces for slab, T-beam, hollow box, frame and arch bridges precast bridges - precast segmental bridges bearings abutments, columns construction methods damages - checking of bridges |
| Literature | Vorlesungsumdruckim STUDiP Rombach, G. (2003): Spannbetonbau. Ernst & Sohn, Berlin Wicke, M. (2002): Anwendung des Spannbetons. Betonkalender 2002, Teil II, S. 113-180, Verlag Ernst & Sohn, Berlin Leonhardt, F. (1980): Vorlesungen über Massivbau. Teil 5: Spannbeton. Berlin Mehlhorn, G. (2007): Handbuch Brücken, Springer Verlag Schäfer, H.; Kaufeld, K. (1997): Massivbrücken. Betonkalender Teil II, S. 443ff, Ernst & Sohn, Berlin Menn, Ch. (1986): Stahlbetonbrücken. Springer Verlag, Wien |

| Course L0604: Design of Pre | ourse L0604: Design of Prestressed Structures and Concreet Bridges | | |
|-----------------------------|--|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | NN | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| | | | | <u> </u> | |
|------------------------------------|---|--|------------------------|---------------------|--|
| Courses | | | | | |
| Гitle | | Тур | Hrs/wk | СР | |
| Modeling Processes in Vadose Zon | e (L2735) | Recitation Section (sma | all) 2 | 2 | |
| Vadose Zone Hydrology (L2732) | | Lecture | 2 | 2 | |
| Vadose Zone Hydrology (L2733) | | Recitation Section (larg | je) 2 | 2 | |
| Module Responsible | Prof. Nima Shokri | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Basic knowledge in water and soil | | | | |
| Knowledge | | | | | |
| | Comfortable with math and physics, critic | al thinking, creative problem solving | | | |
| | Analytic skills | | | | |
| | | | | | |
| Educational Objectives | After taking part successfully, students ha | ave reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | The students will learn about soil chai | racterization (solid and liquid phase), the | energy state of soil | water, the soil wa | |
| | characteristic curve, flow in saturated and | d unsaturated soil as well as about solute trar | isport in soil | | |
| | | | | | |
| | | | | | |
| Skills | Students will work on practical examp | les modelling transport processes in soil u | using different quanti | tative tools includ | |
| | computer simulations and analytical tools | analytical tools. This will help them to apply knowledge in order to solve problems and tasks. | | | |
| | | | | | |
| | | | | | |
| Personal Competence | | | | | |
| • | The module aims at raising awareness | and enthusiasm for new knowledge related | to water soil and (| anvironment This | |
| Social competence | positively contribute to shape their work a | - | i to water, son and e | invironment. mis | |
| | positively contribute to snape their work a | and me environment. | | | |
| | | | | | |
| | | | | | |
| Autonomy | | y problem solving exercises. This will co | ntribute toward their | willingness to w | |
| | independently and responsibly. | | | | |
| Washington | | n Lashuna 0.4 | | | |
| Workload in Hours Credit points | | II LECLULE 04 | | | |
| Course achievement | | | | | |
| Examination | | | | | |
| Examination duration and | | | | | |
| | Report and Presentation | | | | |
| scale | | | | | |
| - | Civil Engineering: Specialisation Computa | | | | |
| Following Curricula | | | | | |
| | Environmental Engineering: Core Qualific | 1 5 | | | |
| | Water and Environmental Engineering: Sp | pecialisation Water: Elective Compulsory | | | |
| | Water and Environmental Engineering: Sp | | | | |

| Course L2735: Modeling Processes in Vadose Zone | |
|---|--|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Mohammad Aziz Zarif |
| Language | EN |
| Cycle | SoSe |
| Content | Numerical tools will be introduced and used to quantify flow and transport processes in soil |
| Literature | NA |

Module Manual M.Sc. "Civil Engineering"

| Course L2732: Vadose Zone | Hydrology |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Nima Shokri |
| Language | EN |
| Cycle | SoSe |
| Content | Soil solid phase characterization, Soil liquid phase characterization, The energy state of soil water, Soil Water Characteristic |
| | Curve, Flow in saturated soil, Flow in unsaturated soil, Solute transport in porous media |
| Literature | - Environmental Soil Physics, by Daniel Hillel |
| | - Soil Physics, Sixth Edition, by William A. Jury and Robert Horton |
| | - Physical Hydrology, Second Edition, by S. Lawrence Dingman |
| | - Introduction to Physical Hydrology, by Martin R. Hendriks |

| Course L2733: Vadose Zone | urse L2733: Vadose Zone Hydrology | |
|---------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Nima Shokri | |
| Language | EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|-------------------------------------|--|---------------------------------------|-------------------------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Soil Mechanics - Selected Topics (L | 0374) | Lecture | 2 | 2 |
| Soil Dynamics (L0452) | | Lecture | 2 | 2 |
| Experimental Researches in Geote | chnics (L0706) | Practical Course | 2 | 2 |
| Module Responsible | Prof. Jürgen Grabe | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Modules: Mathematics I-III, Mechanics I-II, Geotechnic | s I | | |
| Knowledge | Courses: Soil laboratory course, (Applied structural dy | mamics) | | |
| Educational Objectives | After taking part successfully, students have reached | the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students will be able to, | | | |
| | | | | |
| | describe wave propagation in the ground under the measure vibrations and to interpret the data | | | |
| | to measure vibrations and to interpret the data justify when elastodynamic methods are suffic | | | |
| | to reproduce the collapse theorems of plasticit | | | account, |
| | describe the viscous behavior of cohesive so | | or creen deformation | and rate-depende |
| | shear strengths | is and computationally account it | | and rate-depende |
| | as well as to determine the effect of partial sat | uration on the seepage flow and the | e shear strength. | |
| | | | · · · · · · · · · · · · · · · · · · | |
| Skills | After the successful completion of the module the stu | dents should be able to: | | |
| | to derive and apply the basic equation of a sim | ple mass oscillator, | | |
| | to understand the wave propagation in the soil | under dynamic excitation and to de | etect the relevant par | ameters, |
| | to know the essential laboratory and field tests | to determine soil dynamic character | eristics and to evaluat | e them, |
| | to design machine foundations to dynamic load | 1, | | |
| | to measure shocks to perform vibration foreca | st, | | |
| | to evaluate shocks in terms of their effect on p | eople and buildings, | | |
| | to evaluate possibilities of isolation, | | | |
| | to understand mechanisms that cause earthqueet | akes and evaluate earthquakes in t | erms of their magnitu | de and intensity, |
| | to know methods to determine axial pile capac | ity, integrity, and the dynamic bedo | ding modulus, | |
| | to know the mechanisms that lead to a deform mathematically, | nation accumulation due to cyclic lo | bading and to estimate | e these deformatio |
| | to distinguish the area of application of the me | thod of elastodynamics and plastoc | lynamics, | |
| | to detect the undrained shear strength as a full | | | |
| | to capture the visous behaviour of cohesive so | ils and to consider the effects of cr | reep and rate-depend | ent shear strength |
| | calculations, | | | |
| | to consider the impact of the partly saturated | of a seepage and shear strength. | | |
| Personal Competence | | | | |
| • | Students will be able to work in teams to achieve re | sults on measurement and experir | mental principles and | present their resu |
| | together at the end of the semester. | | , . p | |
| | | | | |
| Autonomy | Students are able to assess their own strengths and v | veaknesses and organize their time | and learning manage | ment based on thi |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 8 | 1 | | |
| Credit points | 6 | | | |
| Course achievement | | scription | | |
| | Yes None Subject theoretical and | | | |
| Examination | practical work Written exam | | | |
| Examination duration and | 135 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineerir | g: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engine | | | |
| - | Civil Engineering: Specialisation Coastal Engineering: | | | |
| | Civil Engineering: Specialisation Computational Engin | ooring, Elective Compulsory | | |

| Course L0374: Soil Mechanics | s - Selected Topics |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Hans Mathäus Stanford |
| Language | DE |
| Cycle | SoSe |
| Content | selected topis: |
| Literature | Stress-strain behaviour (experiments, observations, models) Hydraulic behaviour (experiments, observations, models) Physical modelling (similarity theory, 1g model tests, ng model tests) Limit and safety analysis (collapse theorems of plasticity theory, upper and lower bound analysis, limit equilibrium analysis, numerical analysis) Heat transport (heat conduction, convective heat transport, freezing/thawing) Kolymbas D. (2019): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. Springer Verlag, 5. Auflage Muir Wood D. (2004). Geotechnical modelling. CRC Press Nova, R. (2010). Soil mechanics. Wiley Verruijit, A. (2012). Soil mechanics. u r l: https://geo.verruijt.net Verruijit A. (2018). An introduction to soil mechanics. Vol. 30, Springer Series Theory and Applications of Transport in Porous Media |

| Course L0452: Soil Dynamics | |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| | Anne Hagemann |
| Language | |
| Cycle | |
| Content | mass-spring-damper systems, |
| | • wave propagation in soils, |
| | dynamic soil parameters, |
| | Determination of dynamic soil parameters, |
| | • machine foundations, |
| | • in-situ measurement of ground motion, ground motion prediction, evaluation of ground motion, |
| | • ground motion shielding, |
| | introduction into earthquake engineering, |
| | • dynamic pile tests, |
| | • cyclic accumulation, |
| | • plastodynamics |
| Literature | Das B.M.: Fundamentals of Soil Dynamics, Elsevier Empfehlungen des Arbeitskreises Baugrunddynamik. Hrsg. Deutsche Gesellschaft für Geotechnik (DGGT) Haupt W.: Bodendynamik. Vieweg und Teubner Meskouris K. und Hinzen KG.: Bauwerke und Erdbeben. Vieweg Verlag Studer J.A., Koller M.G. und Laue J.: Bodendynamik, Springer Verlag |

| Course L0706: Experimental | Researches in Geotechnics |
|----------------------------|---|
| Тур | Practical Course |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Hans Mathäus Stanford, Göta Bürkner |
| Language | DE |
| Cycle | SoSe |
| Content | The students are supposed to: become acquainted with geotechnical model tests, field tests and laboratory tests as well as corresponding measurement techniques. These compromise amongst others inclinometer measurements and geophone measurements as well as high-grade laboratory tests on the stress-strain relationship of soil specimens, e. g. triaxial tests, simple shear tests and resonant column tests. gain insight into current soil mechanical research. plan, coordinate, perform and evaluate soil mechanical tests in a team. discuss, reflect, review and present the obtained results in a group. An important learning target is the introduction to scientific work for students who plan a scientific career, and for those who will work in practice with the responsibility to order corresponding tests and evaluate the results. The practical laboratory work is based on annualy changing problems, which are however related to the experience and results of the preceding year's course group. |
| Literature | - Grabe, J. (2004): Bodenmechanik und Grundbau, Band 3 der Veröffentlichungsreihe des Instituts für Geotechnik und Baubetrieb, Technische Universität Hamburg-Harburg. - Kolymbas, D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. 2., korrigierte und ergänzte Auflage, Springer |
| | Verlag. Normen zu geotechnischen Versuchsgeräten und Versuchsverfahren: DIN 18135:2012-04: Baugrund, Untersuchung von Bodenproben - Eindimensionaler Kompressionsversuch, Deutsches Institut für Normung, e. V. DIN 18137-2:2011-04: Baugrund, Untersuchung von Bodenproben - Bestimmung der Scherfestigkeit - Teil 2: Triaxialversuch, Deutsches Institut für Normung e. V. |

| Module M0854: Mathe | ematics IV | | | |
|---|---|--|--|-------------------------|
| Courses | | | | |
| Title | | True | Llug hole | C.P. |
| | crontial Equations) (11042) | Typ | Hrs/wk | CP 1 |
| Differential Equations 2 (Partial Differential Equations 2 (Partial Differential Equations 2 (Partial Differential Equations 2) | | Lecture Recitation Section (si | | 1 |
| Differential Equations 2 (Partial Differential Equations 2) | | Recitation Section (la | | 1 |
| Complex Functions (L1038) | | Lecture | 2 | 1 |
| Complex Functions (L1030) | | Recitation Section (si | | 1 |
| Complex Functions (L1042) | | Recitation Section (Ia | | 1 |
| Module Responsible | Prof. Marko Lindner | | 5.7 | |
| Admission Requirements | None | | | |
| Recommended Previous | Mathematics I - III | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have rea | ched the following learning results | | |
| Professional Competence | ······· | | | |
| Knowledge | | | | |
| Khomedye | Students can name the basic concepts in Students can discuss logical connections the help of examples. They know proof strategies and can repro | between these concepts. They are | | |
| Skills | Students can model problems in Mathem capable of solving them by applying estat Students are able to discover and verify fi For a given problem, the students can or results. | olished methods. urther logical connections between t | he concepts studied in | the course. |
| Personal Competence <i>Social Competence</i> <i>Autonomy</i> | Students are able to work together in teal In doing so, they can communicate new or design examples to check and deepen the Students are capable of checking their up | concepts according to the needs of t e understanding of their peers. | heir cooperating partn | ers. Moreover, they car |
| | Students are capable of checking their uprecisely and know where to get help in s Students have developed sufficient persiproblems. | olving them. | | |
| Workload in Hours | Independent Study Time 68, Study Time in Lectu | ure 112 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 60 min (Complex Functions) + 60 min (Different | ial Equations 2) | | |
| scale | | | | |
| Assignment for the | General Engineering Science (German program, | 7 semester): Specialisation Electrica | I Engineering: Compuls | sory |
| Following Curricula | General Engineering Science (German progra | am, 7 semester): Specialisation M | lechanical Engineering | g, Focus Mechatronics |
| . showing curricula | Compulsory | | | |
| . Showing curricula | | | chitecture: Compulsory | / |
| | General Engineering Science (German program, | / semester): Specialisation Naval Ar | | |
| | | | | |
| | General Engineering Science (German program, | | | |
| | General Engineering Science (German program, Engineering: Elective Compulsory | 7 semester): Specialisation Mechan | | |
| | General Engineering Science (German program, Engineering: Elective Compulsory Civil Engineering: Specialisation Computational I | 7 semester): Specialisation Mechan Engineering: Elective Compulsory | | |
| | General Engineering Science (German program, Engineering: Elective Compulsory Civil Engineering: Specialisation Computational I Electrical Engineering: Core Qualification: Comp | 7 semester): Specialisation Mechan Engineering: Elective Compulsory ulsory | ical Engineering, Focus | Theoretical Mechanica |
| | General Engineering Science (German program, Engineering: Elective Compulsory Civil Engineering: Specialisation Computational I | 7 semester): Specialisation Mechan Engineering: Elective Compulsory ulsory | ical Engineering, Focus | Theoretical Mechanica |
| | General Engineering Science (German program, Engineering: Elective Compulsory Civil Engineering: Specialisation Computational I Electrical Engineering: Core Qualification: Comp | 7 semester): Specialisation Mechan Engineering: Elective Compulsory ulsory 7 semester): Specialisation Electrical | ical Engineering, Focus Engineering: Compulse | ory |
| | General Engineering Science (German program, Engineering: Elective Compulsory Civil Engineering: Specialisation Computational I Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, | 7 semester): Specialisation Mechan Engineering: Elective Compulsory ulsory 7 semester): Specialisation Electrical II. Mathematics & Engineering Scier | ical Engineering, Focus Engineering: Compulsi Ice: Elective Compulsion | ory |
| | General Engineering Science (German program, Engineering: Elective Compulsory Civil Engineering: Specialisation Computational I Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, Computer Science in Engineering: Specialisation | 7 semester): Specialisation Mechan Engineering: Elective Compulsory ulsory 7 semester): Specialisation Electrical II. Mathematics & Engineering Scier cal Mechanical Engineering: Elective | ical Engineering, Focus Engineering: Compulsi Ice: Elective Compulsion | ory |
| | General Engineering Science (German program, Engineering: Elective Compulsory Civil Engineering: Specialisation Computational I Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, Computer Science in Engineering: Specialisation Mechanical Engineering: Specialisation Theoretic | 7 semester): Specialisation Mechan Engineering: Elective Compulsory ulsory 7 semester): Specialisation Electrical II. Mathematics & Engineering Scier cal Mechanical Engineering: Elective | ical Engineering, Focus Engineering: Compulsi Ice: Elective Compulsion | ory |
| | General Engineering Science (German program, Engineering: Elective Compulsory Civil Engineering: Specialisation Computational I Electrical Engineering: Core Qualification: Comp General Engineering Science (English program, Computer Science in Engineering: Specialisation Mechanical Engineering: Specialisation Theoretic Mechanical Engineering: Specialisation Mecharica | 7 semester): Specialisation Mechan Engineering: Elective Compulsory ulsory 7 semester): Specialisation Electrical II. Mathematics & Engineering Scier cal Mechanical Engineering: Elective onics: Compulsory | ical Engineering, Focus Engineering: Compulsi Ice: Elective Compulsion | Theoretical Mechanica |

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

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

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

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

| ourse L1041: Complex Functions | |
|--------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Hanna Peywand Kiani |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

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

| Courses | | | | | |
|---------------------------------------|---|---|-------------------|--------------------|--|
| Title | | Тур | Hrs/wk | СР | |
| Nonlinear Structural Analysis (L0277) | | Lecture | 3 | 4 | |
| Nonlinear Structural Analysis (L0279) | | Recitation Section (small) | 1 | 2 | |
| Module Responsible Prof. Alexa | er Düster | | | | |
| Admission Requirements None | | | | | |
| Recommended Previous Knowledge | f partial differential equations is recon | nmended. | | | |
| Knowledge | | | | | |
| Educational Objectives After takin | oart successfully, students have reach | ed the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge Students a | able to | | | | |
| + give an | erview of the different nonlinear phen | omena in structural mechanics. | | | |
| | mechanical background of nonlinear | | | | |
| | | sis, to identify them in a given situation a | and to explain th | eir mathematical a | |
| mechanica | ackground. | | | | |
| Skills Students a | able to | | | | |
| + model n | linear structural problems. | | | | |
| + select fo | given nonlinear structural problem a | suitable computational procedure. | | | |
| + apply fir | element procedures for nonlinear str | uctural analysis. | | | |
| + critically | erify and judge results of nonlinear fin | ite elements. | | | |
| + to transf | their knowledge of nonlinear solution | procedures to new problems. | | | |
| | | | | | |
| Personal Competence | | | | | |
| Social Competence Students a | + solve problems in heterogeneous groups. | | | | |
| | d discuss their results in front of other | ~ | | | |
| | ccept professional constructive criticis | | | | |
| i give une | | | | | |
| | | | | | |
| Autonomy Students a | able to | | | | |
| | r knowledge by means of exercises a | | | | |
| | nemselves with the necessary knowled | | | | |
| + to transf | m the acquired knowledge to similar p | problems. | | | |
| | | | | | |
| | | | | | |
| | Study Time 124, Study Time in Lectur | re 56 | | | |
| Credit points 6 | | | | | |
| Course achievement None | | | | | |
| Examination Written ex | 1 | | | | |
| Examination duration and 120 min | | | | | |
| scale | | | | | |
| Assignment for the Civil Engin | ring: Specialisation Structural Enginee | ring: Elective Compulsory | | | |
| | ring: Specialisation Computational Eng | | | | |
| | | alisation II. Civil Engineering: Elective Com | pulsory | | |
| | ence: Specialisation Modeling: Elective | 1 3 | | | |
| | : Technical Complementary Course: E | 1 3 | | | |
| | : Core Qualification: Elective Compuls | | | | |
| | | ore Qualification: Elective Compulsory | | | |
| | cture and Ocean Engineering: Core Q | | | | |
| Ship and C Theoretica | hore Technology: Core Qualification: | Elective Compulsory | | | |

| Course L0277: Nonlinear Str | uctural Analysis |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Alexander Düster |
| Language | EN |
| Cycle | WiSe |
| Content | 1. Introduction |
| | 2. Nonlinear phenomena |
| | 3. Mathematical preliminaries |
| | 4. Basic equations of continuum mechanics |
| | 5. Spatial discretization with finite elements |
| | 6. Solution of nonlinear systems of equations |
| | 7. Solution of elastoplastic problems |
| | 8. Stability problems |
| | 9. Contact problems |
| Literature | [1] Alexander Düster, Nonlinear Structrual Analysis, Lecture Notes, Technische Universität Hamburg-Harburg, 2014. |
| | [2] Peter Wriggers, Nonlinear Finite Element Methods, Springer 2008. |
| | [3] Peter Wriggers, Nichtlineare Finite-Elemente-Methoden, Springer 2001. |
| | [4] Javier Bonet and Richard D. Wood, Nonlinear Continuum Mechanics for Finite Element Analysis, Cambridge University Press, |
| | 2008. |

| Course L0279: Nonlinear Str | Course L0279: Nonlinear Structural Analysis | |
|-----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Alexander Düster | |
| Language | EN | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | | | |
|------------------------------------|---|--|----------------------------|--------------------------|--------|----|
| Title | | | Tr | n | Hrs/wk | СР |
| Applied Tunnel Constructions (L24) |)7) | | Ty | P cture | 2 | 3 |
| ntroduction to tunnel construction | | | | ture | 1 | 2 |
| ntroduction to tunnel construction | (L1811) | | Ree | citation Section (large) | 1 | 1 |
| Module Responsible | Prof. Jürgen Grabe | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Modules from Bachelo | or studies Civil and env | ironmental engineering: | | | |
| Knowledge | Geotechnics I-II | I | | | | |
| Educational Objectives | After taking part succe | essfully, students have | e reached the following le | earning results | | |
| Professional Competence | | | | | | |
| Knowledge | Knowledge of different tunnel construction types as well as special methods and techniques of subsoil construction. | | | | | |
| Skills | Basic knowledge of tunnel design as well as practical skills in structural tunnel analysis. | | | | | |
| Personal Competence | | | | | | |
| Social Competence | Capacity for teamwork concerning project management and design of tunnels. | | | | | |
| Autonomy | Promotion of independent and creative work flow in the framework of a design exercise. | | | | | |
| Workload in Hours | Independent Study Tir | Independent Study Time 124, Study Time in Lecture 56 | | | | |
| Credit points | 6 | | | | | |
| Course achievement | Compulsory Bonus | Form | Description | | | |
| | No 5 % | Excercises | | | | |
| Examination | Written exam | | | | | |
| Examination duration and | 120 minutes | | | | | |
| scale | | | | | | |
| Assignment for the | Civil Engineering: Spe | cialisation Structural E | ngineering: Elective Con | npulsory | | |
| Following Curricula | Civil Engineering: Spe | cialisation Geotechnica | al Engineering: Compuls | ory | | |
| | Civil Engineering: Spe | cialisation Coastal Eng | ineering: Compulsory | | | |
| | Civil Engineering: Spe | cialisation Water and T | Fraffic: Elective Compuls | ory | | |
| | Civil Engineering: Spe | cialisation Computatio | nal Engineering: Elective | e Compulsory | | |
| | civil Eligilicering. Spe | | 5 5 | 1 2 | | |

| Course L2407: Applied Tunnel Constructions | |
|--|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Jürgen Grabe, Tim Babendererde |
| Language | DE |
| Cycle | WiSe |
| Content | |
| Literature | |

| Course L0707: Introduction t | o tunnel construction |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 1 |
| CP | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Dr. Julian Bubel |
| Language | DE |
| Cycle | WiSe |
| Content | Definitions Historical development in tunneling Geology for tunneling Hard rock tunneling (construction composite and machines) Tunnelung in temporarly stable soil with conventional construction methods Tunneling in soft soils (form of supports, shield types, compressed air application) |
| | Pipe jacking Tunnel Lining, tunnel supporting structures Calculation approaches for supporting structures in shield-driven tunnels Surveying for tunneling Safety requirements Construction Contract Literature and sources |
| Literature | Vorlesung/Übung s. www.tu-harburg.de/gbt |

| Course L1811: Introduction to tunnel construction | |
|---|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Julian Bubel |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Courses | | | | |
|------------------------------------|--|--|--------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Modern discretization methods in s | tructural mechanics (L3043) | Lecture | 2 | 3 |
| Modern discretization methods in s | | Recitation Section (small) | 2 | 3 |
| Module Responsible | Prof. Bastian Oesterle | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Finite Element MethodsFlächentragwerke | | | |
| Educational Objectives | After taking part successfully, students have rea | ached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After successful completion of this module, stur mechanics. | dents can express the basic aspects of moder | n discretization r | nethods in structu |
| Skills | After successful completion of this module, the students will be able to use and further improve modern discretization methods problems in structural mechanics. | | | |
| Personal Competence | | | | |
| Social Competence | Students can | | | |
| | participate in subject-specific and interdi | sciplinary discussions. | | |
| | defend their own work results in front of | | | |
| | promote the scientific development of co | lleagues | | |
| | Furthermore, they can give and accept p | rofessional constructive criticism | | |
| Autonomy | Students are able to gain knowledge of the sub | ject area from given and other sources and a | oply it to new pro | blems. Furthermo |
| | they are able to structure the solution process f | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lea | cture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 90 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Engine | ering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical E | ngineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Structural Engi | neering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Computational | Engineering: Elective Compulsory | | |
| | Theoretical Mechanical Engineering: Specialisat | ion Simulation Technology: Elective Compulso | ry | |

| Course L3043: Modern discre | etization methods in structural mechanics |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Bastian Oesterle |
| Language | EN |
| Cycle | WiSe |
| Content | The course covers variational formulations, various locking phenomena and alternative formulations for finite elements and modern discretization schemes in the context of structural mechanics, like isogeometric analysis. variational formulation of finite elements, mixed variational principles geometrical and material locking effects in structural and solid mechanics hybrid-mixed and enhanced assumed strain finite element formulations, reduced integration and stabilization, DSG method, u-p formulations patch test, stability, convergence linear and non-linear analyses introduction to isogeometric analysis isogeometric beam, plate and shell formulations locking effects and their avoidance in modern, smooth discretization schemes, like isogeometric analysis |
| Literature | lecture notes and selected scientific papers O.C. Zienkiewicz, R.L. Taylor, and J.Z. Zhu: Finite Element Method: Its Basis and Fundamentals. Elsevier, 2013. J. Austin Cottrell, Thomas J. R Hughes, Yuri Bazilevs: Isogeometric Analysis: Toward Integration of CAD and FEA. Wiley, 2009. |

| Course L3044: Modern discre | urse L3044: Modern discretization methods in structural mechanics | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Bastian Oesterle | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | |
|--------------------------------------|---|---|----------------|-----------------|
| Title | | Тур | Hrs/wk | СР |
| Scientific Working in Computationa | Engineering (L2764) | Project-/problem-based Learning | 4 | 6 |
| Module Responsible | Prof. Kay Smarsly | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge in scientific writing. String interest in to | pics related to computing in civil engine | ering. | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the | e following learning results | | |
| Professional Competence | | | | |
| <i>Skills</i> Personal Competence | course instructors and in collaboration with each other, the students will also learn to understand the complex process of scientific thinking, being able to accurately plan, implement and analyze scientific projects, such as prospective master theses. A proje will be conducted throughout the semester, which will contribute to the grade. Since scientific writing is of particular importance this course, a scientific paper will be developed based, which is a prerequisite for the final examination. The paper will be writted based on the project conducted within this course. Project meetings in small groups, presentations, and critical discussions scientific publications are further key activities. | | | |
| • | The students will be able to work in a multidisciplinary te | am and develop communication skills no | ecessary for p | roblem solving. |
| Autonomy | The students will be able to extend their knowledge and apply it to solve scientific problems by working independently in a proje | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | 10 pages of work with 15-minute oral presentation | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Water and Traffic: Election | ve Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Structural Engineering: | | | |
| | Civil Engineering: Specialisation Computational Engineer | • • • | | |
| | Computer Science: Specialisation II: Intelligence Enginee | ring: Elective Compulsory | | |

| ourse L2764: Scientific Working in Computational Engineering | | |
|--|--|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 4 | |
| СР | 6 | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | |
| Lecturer | Prof. Kay Smarsly | |
| Language | EN | |
| Cycle | WiSe/SoSe | |
| Content | In the course, a scientific problem of practical relevance will first be defined, taking into account the interests of the students participating in the course. The scientific problem will then systematically be solved within the framework of a comprehensive project. The principles of scientific working will be taught based on the scientific problem defined previously. As an integral part of scientific working, fundamentals of scientific writing will be presented and applied to a scientific paper to be written during the course. Topics related to scientific writing include structuring in scientific writing (structuring the abstract, the introduction, the main part, the summary and conclusions, and the acknowledgments and references) and recommendations on effective scientific writing (principles of composition, use of English in scientific writing, useful tips, creating figures, writing in mathematics, referencing, and formal email correspondence). A final paper and a final presentation will be assembled by the students. | |
| Literature | Smarsly, K. & Dragos, K., 2019. Scientific Writing in Engineering. Tredition, Hamburg, Germany. | |

Module M0969: Selected Topics in Civil Engineering

| Courses | | | | |
|---|--|---|---------------------|----------------------|
| Title | | Тур | Hrs/wk | СР |
| Design of Composite Bridges (L3092) | | Integrated Lecture | 2 | 3 |
| Analysis of Offshore Structures (L1867) | | Lecture | 1 | 1 |
| Energy Geotechnics (L3227) | | Lecture | 3 | 3 |
| Solid Matter Process Technology fo | r Biomass (L0052) | Lecture | 2 | 3 |
| Forum I - Geotechnics and Construe | ction Management (L1634) | Seminar | 1 | 1 |
| Forum II - Geotechnics and Constru | ction Management (L1635) | Seminar | 1 | 1 |
| Timber Structures (L1151) | | Seminar | 2 | 2 |
| Innovative Timber Construction (L2 | 666) | Lecture | 2 | 4 |
| Glass Structures (L1152) | | Lecture | 2 | 2 |
| Glass Structures (L1447) | | Recitation Section (large) | 1 | 1 |
| Sustainable landfill design and oper | ration (L3270) | Integrated Lecture | 3 | 3 |
| Special Topics in Steel Design (L30 | 91) | Integrated Lecture | 2 | 3 |
| Special topics of civil engineering 1 | CP (L2378) | | 1 | 1 |
| Special topics of civil engineering 2 | LP (L2379) | | 2 | 2 |
| Special topics of civil engineering 3 | LP (L2380) | | 3 | 3 |
| Structural Design (L2789) | | Seminar | 2 | 2 |
| Module Responsible | Prof. Frank Schmidt-Döhl | | | |
| Admission Requirements | None | | | |
| Recommended Previous | none | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached | d the following learning results | | |
| Professional Competence | | | | |
| Knowledge | | | | |
| | Students are able to find their way through se | | | |
| | Students are able to explain basic models and | I procedures in selected special areas of | civil and structura | al engineering. |
| | Students are able to interrelate scientific and | technical knowledge. | | |
| Skills | • Students are able to apply basic methods in se | elected areas of civil and structural engin | neering. | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | | | | |
| Autonomy | Students can chose independently, in which to courses. | fields they want to deepen their knowled | dge and skills th | rough the election o |
| Workload in Hours | Depends on choice of courses | | | |
| Credit points | 6 | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineeri | ng: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engine | eering: Elective Compulsory | | |
| - | Civil Engineering: Specialisation Coastal Engineering | : Elective Compulsory | | |
| | Civil Engineering: Specialisation Water and Traffic: E | | | |
| | Civil Engineering: Specialisation Computational Engin | | | |
| | civit Engineering, specialisation computational Engli | icening. Elective compulsory | | |

| Course L3092: Design of Composite Bridges | |
|---|---|
| Тур | Integrated Lecture |
| Hrs/wk | 2 |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Examination Form | Klausur |
| Examination duration and | 90 min |
| scale | |
| Lecturer | Prof. Marcus Rutner |
| Language | DE |
| Cycle | SoSe |
| Content | |
| Literature | |

Module Manual M.Sc. "Civil Engineering"

| Course L1867: Analysis of Of | |
|------------------------------|---|
| Тур | Lecture |
| | |
| CP Workload in Hours | 1 Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | |
| Examination duration and | |
| scale | |
| Lecturer | Dr. Said Fawad Mohammadi |
| Language | DE/EN |
| Cycle | SoSe |
| Content | Topic 1: Types of Offshore Structures, Fixed and floating structures for Oil & Gas and Offshore Wind industry |
| | Topic 2: Wave Forces, Morisons equation |
| | Topic 3: Irregular Seastates, Power spectrum and application of FFT |
| | Topic 4: Additional Environmental Forces, wind spectra, current forces |
| | Topic 5: Linear-Time-Invariant Systems, response of an LTI-system in frequency domain |
| | Topic 6: Tubular Welded Connections, stress concentration factors, weld geometry |
| | Topic 7: Introduction to Fracture Mechanics, criteria for fracture initiation and crack growth |
| | Topic 8: Time and Frequency Domain Fatigue Analyses, rainflow counting, application of LTI-systems for frequency domain fatigue |
| | Topic 9: Offshore Installation and Exam, installation of structures, pile driving, pipe laying techniques |
| Literature | Chakrabarti, Handbook of Offshore Engineering, 2005 |
| | Sarpkaya, Wave Forces on Offshore Structures, 2010 |
| | Faltinsen, Sea Loads on Ships and Offshore Structures, 1998 |
| | Sorensen, Basic Coastal Engineering, 2006 |
| | Dowling, Mechanical Behavior of Materials, 2007 |
| | Haibach, Betriebsfestigkeit, 2006 |
| | Marshall, Design of Welded Tubular Connections, 1992 |
| | Newland, Random vibrations, spectral and wavelet analysis, 1993 |
| | |

| Course L3227: Energy Geotechnics | | |
|----------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | |
| Examination Form | Schriftliche Ausarbeitung (laut FPrO) | |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt | |
| scale | | |
| Lecturer | Pauline Kaminski | |
| Language | DE/EN | |
| Cycle | WiSe | |
| Content | Energy geotechnics is a young field in geotechnical engineering with the aim of developing sustainable geotechnical solutions for future-oriented issues relating to the production, transport, operation, decommissioning, and waste utilisation of various energy sources. Examples of possible fields of activity in energy geotechnics include geothermal energy and thermally activated foundation components, foundations for onshore and offshore wind turbines, the decommissioning of mining facilities and the handling of waste products from fossil fuels such as tailings and the geological storage of CO2. Relevant soil mechanical processes in these applications include the thermo-hydro-mechanically coupled behaviour of soils, multiphase flow in porous media and partially saturated soils. The lecture gives an overview of various aspects of energy geotechnics and provides in-depth knowledge of the associated soil mechanical processes. In addition, CO2-scarce geotechnical applications are discussed and emission estimates as well as the optimisation of geotechnical structures according to sustainability aspects are addressed. | |
| Literature | | |

| | Process Technology for Biomass |
|--------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Examination Form | Klausur |
| Examination duration and | 60 min |
| scale | |
| Lecturer | Prof. Werner Sitzmann |
| Language | DE |
| Cycle | SoSe |
| Content | The industrial application of unit operations as part of process engineering is explained by actual examples of solid biomass |
| | processes. Size reduction, transportation and dosing, drying and agglomeration of renewable resources are described as important |
| | unit operations when producing solid fuels and bioethanol, producing and refining edible oils, when making Btl - and WPC - |
| | products. Aspects of explosion protection and plant design complete the lecture. |
| Literature | Kaltschmitt M., Hartmann H. (Hrsg.): Energie aus Bioamsse, Springer Verlag, 2001, ISBN 3-540-64853-4 |
| | Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz, Schriftenreihe Nachwachsende Rohstoffe, |
| | Fachagentur Nachwachsende Rohstoffe e.V. www.nachwachsende-rohstoffe.de |
| | Bockisch M.: Nahrungsfette und -öle, Ulmer Verlag, 1993, ISBN 380000158175 |
| | |

| Course L1634: Forum I - Geotechnics and Construction Management | |
|---|---|
| Тур | Seminar |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | Mündliche Prüfung |
| Examination duration and | 30 min |
| scale | |
| Lecturer | Prof. Jürgen Grabe |
| Language | DE |
| Cycle | WiSe |
| Content | Lectures about projects and issues with practical and scientific relevance. |
| Literature | |

| Course L1635: Forum II - Geotechnics and Construction Management | |
|--|---|
| Тур | Seminar |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | Mündliche Prüfung |
| Examination duration and | 30 min |
| scale | |
| Lecturer | Prof. Jürgen Grabe |
| Language | DE |
| Cycle | SoSe |
| Content | Lectures about projects and issues with practical and scientific relevance. |
| Literature | |

| Course L1151: Timber Structures | |
|---------------------------------|---|
| Тур | Seminar |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Examination Form | Referat |
| Examination duration and | 90 min |
| scale | |
| Lecturer | Prof. Torsten Faber |
| Language | DE |
| Cycle | WiSe |
| Content | |
| Literature | |

| Course L2666: Innovative Timber Construction | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 4 | |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 | |
| Examination Form | Schriftliche Ausarbeitung | |
| Examination duration and | 45 Minuten | |
| scale | | |
| Lecturer | Dr. Andreas Meisel | |
| Language | DE | |
| Cycle | WiSe | |
| Content | | |
| Literature | - Blass, J.: "Ingenieurholzbau" | |
| | - Schickhofer, G.: "BSPhandbuch: Holz-Massivbauweise in Brettsperrholz" | |
| | - Informationsdienst Holz: div. Merkblätter und Broschüren | |
| | - Wallner-Novak M.: Brettsperrholz Bemessung, Band 1 und 2 | |
| | - Gerner M.: "Fachwerk: Entwicklung, Instandsetzung, Neubau" | |
| | - Meisel, A.: "Historische Dachwerke: Beurteilung, realitätsnahe statische Analyse und Instandsetzung" | |
| | - Kempe K.: "Dokumentation Holzschädlinge" | |
| | - Huckfeldt T.: "Hausfäule- und Bauholzpilze" | |

| Course L1152: Glass Structures | | |
|--------------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Examination Form | Mündliche Prüfung | |
| Examination duration and | | |
| scale | | |
| Lecturer | Marvin Matzik | |
| Language | DE | |
| Cycle | WiSe | |
| Content | Glass structures | |
| | - Introduction of the material glass (production, refinement, material characteristic) | |
| | - design of facades | |
| | - facade types | |
| | - static calculation of glazing | |
| | - static calculation of facades | |
| | - load bearing behavior of glazing (plate or membrane stiffness) | |
| | - vertical / horizontal glazing with safety-related requirements | |
| | - glass structures | |
| | - fire safety of glass facades | |
| | - construction physics of facades and glazing | |
| Literature | | |

| Course L1447: Glass Structures | |
|--------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | Mündliche Prüfung |
| Examination duration and | |
| scale | |
| Lecturer | Marvin Matzik |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L3270: Sustainable la | andfill design and operation |
|------------------------------|--|
| Тур | Integrated Lecture |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Examination Form | Klausur |
| Examination duration and | 60 min |
| scale | |
| Lecturer | Dr. Marco Ritzkowski |
| Language | EN |
| Cycle | SoSe |
| Content | The course introduces the development of modern waste resource management and demonstrates the importance of landfills in the context of recycling processes. Based on international (EU) and national legislation, the current landfill situation is presented and the future significance of landfills will be discussed. A central element of the course deals with the main transformation processes in the landfilled waste, the emission of gases and leachate, the long-term behaviour of landfills as well as aftercare and after-utilisation measures. Further focal points of the course are measures for the sustainable reduction of environmentally and climate-damaging emissions and aspects of landfill technology in an international context. |
| Literature | Waste Management. Bernd Bilitewski; Georg Härdtle; Klaus Marek (Eds.), ISBN: 9783540592105, Springer Verlag Lehrbuchsammlung der TUB, Signatur USH-305 Solid Waste Technology and Management. Thomas Christensen (Ed.), ISBN: 978-1-4051-7517-3, Wiley Verlag Lesesaal 2: US - Umweltschutz, Signatur USH-332 Solid Waste Landfilling - Concepts, Processes, Technologies. Cossu, R. and Stegmann, R. (Eds.), ISBN: 978-0-12-818336-6 PDF (Volltext) über TUB |

| Course L3091: Special Topics in Steel Design | |
|--|---|
| Тур | Integrated Lecture |
| Hrs/wk | 2 |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Examination Form | Klausur |
| Examination duration and | 90 min |
| scale | |
| Lecturer | Prof. Marcus Rutner, Nikolay Lalkovski |
| Language | DE |
| Cycle | SoSe |
| Content | |
| Literature | |

| Course L2378: Special topics of civil engineering 1CP | | |
|---|---|--|
| Тур | | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Examination Form | Fachtheoretisch-fachpraktische Arbeit | |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt | |
| scale | | |
| Lecturer | Dozenten des SD B | |
| Language | DE | |
| Cycle | WiSe/SoSe | |
| Content | The course occurs only if required. The content is defined at short notice. | |
| Literature | Die Literatur wird kurzfristig festgelegt. | |

| Course L2379: Special topics of civil engineering 2 LP | | |
|--|---|--|
| Тур | | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Examination Form | Fachtheoretisch-fachpraktische Arbeit | |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt | |
| scale | | |
| Lecturer | Dozenten des SD B | |
| Language | DE | |
| Cycle | WiSe/SoSe | |
| Content | The course occurs only if required. The content is defined at short notice. | |
| Literature | Die Literatur wird kurzfristig festgelegt. | |

| Course L2380: Special topics of civil engineering 3 LP | | |
|--|---|--|
| Тур | | |
| Hrs/wk | 3 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | |
| Examination Form | Fachtheoretisch-fachpraktische Arbeit | |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt | |
| scale | | |
| Lecturer | Dozenten des SD B | |
| Language | DE | |
| Cycle | WiSe/SoSe | |
| Content | The course occurs only if required. The content is defined at short notice. | |
| Literature | Die Literatur wird kurzfristig festgelegt. | |

| Course L2789: Structural Design | | |
|---------------------------------|---|--|
| Тур | Seminar | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Examination Form | Mündliche Prüfung | |
| Examination duration and | 20 min | |
| scale | | |
| Lecturer | Dr. Jan Mittelstädt | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | | |
| Literature | [1] Structure Systems by Heino Engel, Hantje Cantz, 3rd edition (Feb 2007), ISBN-10: 3775718761 | |
| | Form and Force, Designing Efficient, Expressive Structures by Allan, E., Zalewski, W. et al, John Wiley and | |
| | Sons; 1st edition (Sept 2009), ISBN-10: 047017465X | |
| | [2] Peter Rice: An Engineer Imagines, ISBN-10 : 1849944237 | |
| | [3] Konrad Wachsmann and the Grapevine Structure by C. Sumi et al., Park Books (Oct 2018), ISBN-10: | |
| | 9783038601104 | |
| | [4] Manual of Multi-Story Timber Construction by Hermann Kaufmann, Stefan Krotsch, Stefan Winter, DETAIL, | |
| | (June 2018), ISBN-10: 3955533948 | |
| | [5] The Art of Structural Design: A Swiss Legacy by B. Billington, Princeton University Art Museum; First Edition | |
| | edition (Mar 2003), ISBN-10: 0300097867 | |
| | [6] Structured Lineages: Learning from Japanese Structural Design by G. Nordenson et al, The Museum of | |
| | Modern Art (Jul 2019), ISBN-10: 1633450562 | |
| | [7] The Structure: Works of Mahendra Raj by V. Mehta, R. Mehndiretta, A. Huber, Park Books (Oct 2015), | |
| | ISBN-10: 3038600253 | |
| | | |
| | | |

| Courses | |
|-----------------------------|---|
| Title | Typ Hrs/wk CP |
| Module Responsible | Dozenten des SD B |
| Admission Requirements | None |
| Recommended Previous | Subjects of the computational engineering specialisation. |
| Knowledge | |
| Educational Objectives | After taking part successfully, students have reached the following learning results |
| Professional Competence | |
| Knowledge | The students are able to demonstrate their detailed knowledge in the field of computational engineering engineering. They ca exemplify the state of technology and application and discuss critically in the context of actual problems and general conditions of science and society. |
| | The students can develop solving strategies and approaches for fundamental and practical problems in computational engineerin. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view points of science and society. |
| | Scientific work techniques that are used can be described and critically reviewed. |
| Skills | The students are able to independently select methods for the project work and to justify this choice. They can explain how thes methods relate to the field of work and how the context of application has to be adjusted. General findings and furthed developments may essentially be outlined. |
| Personal Competence | |
| Social Competence | The students are able to condense the relevance and the structure of the project work, the work steps and the sub-problems for the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to the colleagues. |
| Autonomy | The students are capable of independently planning and documenting the work steps and procedures while considering the give deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedbac from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology. |
| Workload in Hours | Independent Study Time 180, Study Time in Lecture 0 |
| Credit points | 6 |
| Course achievement | None |
| Examination | Study work |
| Examination duration and | see FSPO |
| scale | |
| Assignment for the | Civil Engineering: Specialisation Computational Engineering: Compulsory |
| Following Curricula | |

| | ing and Excavation Law | | | |
|-----------------------------------|---|--|---------------------------|--------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Construction law BGB and VOB - la | | Lecture | 2 | 3 |
| | ction (excavation) practice (L3181) | Lecture | 2 | 3 |
| Module Responsible | | | | |
| Admission Requirements | | | | |
| Kecommended Previous Knowledge | Complete modules: Geotechnics I-III | | | |
| _ | After taking part successfully, students have re | ached the following learning results | | |
| Professional Competence | | | | |
| - | Students will gain knowledge of | | | |
| | the history of civil engineering law, | | | |
| | basics of foundation and civil engineerin | g law, | | |
| | legal aspects of technical regulations in | civil engineering (with case studies), | | |
| | the civil engineering contract, | | | |
| | the liability of the designer and contract | or in civil engineering, | | |
| | the subsoil risk and the system risk, | | | |
| | the total debt in (civil) engineering law, | | | |
| | the (construction) conflict, dispute avoid | | ess, | |
| | the systematics of construction contract law, | | | |
| | the BGB construction contract law, | | | |
| | responsibilities on the construction site, remunantian and contract management | | | |
| | remuneration and contract management liability for defacts | -, | | |
| | liability for defects,public procurement law | | | |
| | Disturbed construction processes: How r | nuch money am Lentitled to? | | |
| | Correct calculation of supplements. | inden money and enclose to: | | |
| | | | | |
| Skille | Students learn to apply legal aspects in planni | ng and construction in a legally balance | ad way Students learn l | now to use legal : |
| Skiiis | construction management aspects in practice | | | |
| | to manage the construction project optimally. | (planning and construction) on the con- | struction site in a targe | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Students can work in groups and support each | other in finding solutions. | | |
| Autonomy | Students are able to assess their own strength | and weaknesses and organize their tin | ne and learning manage | ment based on th |
| Workload in Hours | Independent Study Time 124, Study Time in Le | cture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Oral exam | | | |
| Examination duration and | 30 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Engine | | | |
| Following Curricula | | 5 5 1 5 | | |
| | Civil Engineering: Specialisation Structural Engi | • • • | | |
| | Civil Engineering: Specialisation Water and Tra | | | |
| | Civil Engineering: Specialisation Computational | Engineering: Elective Compulsory | | |

| Course L3182: Construction | ourse L3182: Construction law BGB and VOB - law in (excavation) practice | | |
|----------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Günther Schalk | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | | | |
| Literature | Literatur: | | |
| | - Folienskript (in der Vorlesung erhältlich) | | |
| | - Fuchs/Maurer/Schalk: Handbuch Tiefbaurecht | | |

| Course L3181: Construction | ourse L3181: Construction disputes from construction (excavation) practice | | |
|----------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Ingo Junker | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | | | |
| Literature | | | |

| Module M2025: Finite | element modeling of structure | es | | |
|-------------------------------------|---|---|------------------|----------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Finite element modeling of structur | es (L3046) | Lecture | 2 | 3 |
| Finite element modeling of structur | es (L3047) | Recitation Section (small) | 2 | 3 |
| Module Responsible | Prof. Bastian Oesterle | | | |
| Admission Requirements | None | | | |
| Recommended Previous Knowledge | Finite Element MethodsThin-walled structures | | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After successful completion of this module, st | tudents can express the basic aspects of modelli | ng of structures | with finite elements |
| Skills | After successful completion of this module, the students will be able to model structures with finite elements and to analysi structures using appropriate computational methods. | | | |
| Personal Competence | | | | |
| Social Competence | Students can | | | |
| | participate in subject-specific and inter | rdisciplinary discussions, | | |
| | defend their own work results in front | of others | | |
| | promote the scientific development of | colleagues | | |
| | • Furthermore, they can give and accept | t professional constructive criticism | | |
| Autonomy | | ubject area from given and other sources and ap is for problems in the area of finite element mode | | |
| Workload in Hours | Independent Study Time 124, Study Time in | Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | written elaboration of a project work (10-15 p | pages) | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Computation | al Engineering: Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Coastal Engi | neering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Geotechnica | l Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Structural Er | ngineering: Elective Compulsory | | |
| | Theoretical Mechanical Engineering: Specialis | sation Simulation Technology: Elective Compulso | ry | |

| Course L3046: Finite element modeling of structures | | |
|---|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Bastian Oesterle | |
| Language | EN | |
| Cycle | WiSe | |
| Content | Basic phenomena and aspects of the finite element modelling of structures are discussed. Besides theoretical decription of the phenomena and methods, a strong focus is on the practical use a commercial finite element software within computer-based exercises. The covered topics are: finite element modeling of trusses/beams/frames, plates subject to in-plane/out-of-plane loading and shells convergence properties of displacements and stresses singularities locking effects critical assessment, interpretation and check of results mixed-dimensional coupling of finite elements geometrically linear and non-linear, and material linear and non-linear analyses stability: bifurcation and snap-through problems dynamic problems, modal analyses | |
| Literature | Vorlesungsmanuskript, Vorlesungsfolien | |

| Course L3047: Finite elemen | ourse L3047: Finite element modeling of structures | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Bastian Oesterle | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

Specialization Water and Traffic

| Courses | | | | | |
|-------------------------------------|---|-----------------------|--|------------|----|
| Title | | | Тур | Hrs/wk | СР |
| Applied Tunnel Constructions (L240 | 07) | | Lecture | 2 | 3 |
| Introduction to tunnel construction | | | Lecture | 1 | 2 |
| Introduction to tunnel construction | (L1811) | | Recitation Section (larg | e) 1 | 1 |
| Module Responsible | Prof. Jürgen Grabe | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Modules from Bache | elor studies Civil an | d environmental engineering: | | |
| Knowledge | Geotechnics | -11 | | | |
| Educational Objectives | After taking part suc | ccessfully, students | have reached the following learning results | | |
| Professional Competence | | | | | |
| Knowledge | Knowledge of different tunnel construction types as well as special methods and techniques of subsoil construction. | | | | |
| Skills | Basic knowledge of tunnel design as well as practical skills in structural tunnel analysis. | | | | |
| Personal Competence | | | | | |
| Social Competence | Capacity for teamwork concerning project management and design of tunnels. | | | | |
| Autonomy | Promotion of independent and creative work flow in the framework of a design exercise. | | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | | |
| Credit points | 6 | | | | |
| Course achievement | | Form | Description | | |
| | No 5 % | Excercises | | | |
| | Written exam | | | | |
| Examination duration and | 120 minutes | | | | |
| scale | | | | | |
| • | | | aral Engineering: Elective Compulsory | | |
| Following Curricula | | | hnical Engineering: Compulsory | | |
| | 5 5 1 | | l Engineering: Compulsory | | |
| | | | and Traffic: Elective Compulsory | | |
| | | | itational Engineering: Elective Compulsory | | |
| | International Manag | ement and Enginee | ring: Specialisation II. Civil Engineering: Elective | Compulsory | |

| Course L2407: Applied Tunnel Constructions | | |
|--|---|--|
| Тур | Lecture | |
| Hrs/wk | | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Jürgen Grabe, Tim Babendererde | |
| Language | DE | |
| Cycle | WiSe | |
| Content | | |
| Literature | | |

| Course L0707: Introduction t | to tunnel construction | | |
|------------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | | | |
| СР | | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Dr. Julian Bubel | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Definitions Historical development in tunneling Geology for tunneling Hard rock tunneling (construction composite and machines) Tunnelung in temporarly stable soil with conventional construction methods Tunneling in soft soils (form of supports, shield types, compressed air application) Pipe jacking | | |
| | Tunnel Lining, tunnel supporting structures Calculation approaches for supporting structures in shield-driven tunnels Surveying for tunneling Safety requirements Construction Contract Literature and sources | | |
| Literature | Vorlesung/Übung s. www.tu-harburg.de/gbt | | |

| Course L1811: Introduction to tunnel construction | | |
|---|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | | |
| CP | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dr. Julian Bubel | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|-------------------------------------|--|--|-------------------|---------------------|
| Title | | Тур | Hrs/wk | СР |
| Examination of Materials, Structura | l Condition and Damages (L0260) | Lecture | 3 | 4 |
| Examination of Materials, Structura | I Condition and Damages (L0261) | Recitation Section (small) | 1 | 2 |
| Module Responsible | Prof. Frank Schmidt-Döhl | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge about building materials or r | naterial science, for example by the mo | dule Building Ma | terials and Buildin |
| Knowledge | Chemistry. | | | |
| Educational Objectives | After taking part successfully, students have reac | hed the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students are able to describe the rules for t methods for the testing of building material prope testing methods. | | | |
| Skills | The students are able to responsibly discover the They are able to chose suitable methods for the the examination of the structural conditions of bu are able to describe an examination in form of a | testing and inspection of construction produce in the second | cts, the examina | - |
| Personal Competence | | | | |
| Social Competence | The students can describe the different roles of framework of material testing. They can describe | | - | on bodies within tl |
| Autonomy | The students are able to make the timing and the | operation steps to learn the specialist know | ledge of a very e | xtensive field. |
| Workload in Hours | Independent Study Time 124, Study Time in Lectu | ıre 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engine | ering: Elective Compulsory | | |
| - | Civil Engineering: Specialisation Geotechnical Eng | | | |
| | Civil Engineering: Specialisation Coastal Engineer | ing: Elective Compulsory | | |
| | Civil Engineering: Specialisation Water and Traffic | : Elective Compulsory | | |
| | International Management and Engineering: Spec | ialisation II. Civil Engineering: Elective Comp | oulsory | |
| | Materials Science and Engineering: Specialisation | | - | |
| | Materials Science: Specialisation Engineering Mat | | | |

| Course L0260: Examination of Materials, Structural Condition and Damages | | | |
|--|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 3 | | |
| СР | 4 | | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | | |
| Lecturer | Prof. Frank Schmidt-Döhl | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Materials testing and marking process of construction products, testing methods for building materials and structures, testing | | |
| | reports and expert opinions, describing the condition of a structure, from symptons to the cause of damages | | |
| Literature | Frank Schmidt-Döhl: Materialprüfung im Bauwesen. Fraunhofer irb-Verlag, Stuttgart, 2013. | | |

| Course L0261: Examination of Materials, Structural Condition and Damages | | |
|--|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Frank Schmidt-Döhl | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|---|--|--|----------------|-------------------|
| Courses | T | | Line (colo | <u></u> |
| Title Integrated Transportation Planning | Tyj (L1068) Pro | p ject-/problem-based Learning | Hrs/wk 4 | CP 6 |
| Module Responsible | | ,, p | | - |
| Admission Requirements | None | | | |
| Recommended Previous | | rgraduate class "Transport P | lanning and Tr | raffic Engineerin |
| Knowledge | | . <u>.</u> | j | |
| Educational Objectives | After taking part successfully, students have reached the following le | earning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to: | | | |
| | • describe interdenendensies between land use/lesstion sheise | and transportation (mobility) | habaylayr | |
| | describe interdependencies between land-use/location choice explain and evaluate the social, ecological and economic effect | | | res |
| | relate current issues in the area of integrated transport planni | | | |
| | | | | |
| Skills | Students are able to: | | | |
| | • supptify important parameters, which influence travel doman | d ar are influenced by it | | |
| | quantify important parameters, which influence travel demander comprehensively examine a pre-defined or self-selected topic | | es nersnective | and document t |
| | results in accordance with scientific conventions. | | es perspective | |
| Personal Competence Social Competence | Students are able to: | | | |
| | provide feedback on topical contents and their teaching. constructively handle feedback on their own work. | | | |
| | produce results in group work and document these. | | | |
| | р | | | |
| Autonomy | Students are able to: | | | |
| | assess potential consequences of their future professional act | ivities | | |
| | independently plan working on a pre-defined project topic, ac | quire the necessary knowled | ge and use ap | propriate means |
| | its execution. | | | |
| | | | | |
| | | | | |
| | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | Written elaboration | | | |
| Examination duration and | written assignment with presentation during the semester | | | |
| scale Assignment for the | Civil Engineering: Specialization Structural Engineering: Elective Con | anulsony | | |
| Following Curricula | Civil Engineering: Specialisation Structural Engineering: Elective Con Civil Engineering: Specialisation Geotechnical Engineering: Elective C | | | |
| i cheming curricula | Civil Engineering: Specialisation Geotechnical Engineering: Elective Composition Coastal Engineering: Elective Coastal Engineering: Electi | | | |
| | Civil Engineering: Specialisation Water and Traffic: Compulsory | | | |
| | Logistics, Infrastructure and Mobility: Specialisation Infrastructure and | nd Mobility: Elective Compuls | ory | |
| | Water and Environmental Engineering: Specialisation Cities: Compute | sory | | |

| Course L1068: Integrated Tr | ansportation Planning |
|-----------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| СР | 6 |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Lecturer | Prof. Carsten Gertz, Dr. Philine Gaffron, Jacqueline Bianca Maaß |
| Language | DE |
| Cycle | WiSe |
| | The course will provide students with an understanding of interdependencies between land-use and transportation. Specific topics include a.o.: interactions between transport and the environment and consequent limitations characteristics of integrated planning complex planning processes interdependencies of location choice and mobility behaviour transport and land-use policies project on current issues in transportation studies |
| Literature | Kutter, Eckhard (2019) Stadtstruktur und Erreichbarkeit in der postfossilen Zukunft. Erich Schmidt Verlag. Berlin. Gies, Huber u. a. (Hrsg.) (93. Ergänzung 2022) Handbuch der kommunalen Verkehrsplanung. Herbert Wichmann Verlag. Berlin, Offenbach. (Loseblattsammlung mit kontinuierlichen Ergänzungen) |

| Courses | | | | |
|--|--|--|--------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| Chemistry of Drinking Water Treatment (L0311) | | Lecture | 2 | 1 |
| Chemistry of Drinking Water Treat | ment (L0312) | Recitation Section (large) | 1 | 2 |
| Water Resource Management (L04 | 02) | Lecture | 2 | 2 |
| Water Resource Management (L04 | 03) | Recitation Section (small) | 1 | 1 |
| Module Responsible | Prof. Mathias Ernst | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Knowledge of water management and th | ne key processes involved in water treatment. | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students h | nave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students will be able to outline key are | as of conflict in water management, as well as the | eir mutual depend | dence for sustaina |
| | | evant economic, environmental and social factors. | | |
| | outline the organisational structures of w | vater companies. They will be able to explain the av | ailable water trea | tment processes |
| | the scope of their application. | | | |
| | | | | |
| Skills | Students will be able to assess com | plex problems in drinking water production and | d establish soluti | ons involving w |
| | - | hey will be able to assess the evaluation methods | | |
| | be able to carry out chemical calculati | ons for selected treatment processes and apply g | enerally accepted | d technical rules |
| | standards to these processes. | | | |
| Personal Competence | | | | |
| | | s, students will be able to develop and document c | omplex solutions | for the managem |
| <i>p</i> | | will be able to take an appropriate professional po | | • |
| | · · · | int solutions in teams of diverse experts and presen | | |
| | | | | |
| Autonomy | Students will be in a position to work on | a subject independently and present on this subject | | |
| Workload in Hours | Independent Study Time 96, Study Time | in Lecture 84 | | |
| Credit points | | | | |
| | | | | |
| Course achievement | Written exam | | | |
| Course achievement Examination | WIILLEITEXAIII | | | |
| | | | | |
| Examination | | | | |
| Examination Examination duration and scale | 60 min (chemistry) + presentation | ral Engineering: Elective Compulsory | | |
| Examination Examination duration and scale Assignment for the | 60 min (chemistry) + presentation Civil Engineering: Specialisation Structur | | | |
| Examination Examination duration and scale | 60 min (chemistry) + presentation Civil Engineering: Specialisation Structur Civil Engineering: Specialisation Geotech | nnical Engineering: Elective Compulsory | | |
| Examination Examination duration and scale Assignment for the | 60 min (chemistry) + presentation Civil Engineering: Specialisation Structur Civil Engineering: Specialisation Geotech Civil Engineering: Specialisation Water a | nnical Engineering: Elective Compulsory nd Traffic: Compulsory | | |
| Examination Examination duration and scale Assignment for the | 60 min (chemistry) + presentation Civil Engineering: Specialisation Structur Civil Engineering: Specialisation Geotech Civil Engineering: Specialisation Water a Civil Engineering: Specialisation Coastal | nnical Engineering: Elective Compulsory nd Traffic: Compulsory Engineering: Elective Compulsory | rv | |
| Examination Examination duration and scale Assignment for the | 60 min (chemistry) + presentation Civil Engineering: Specialisation Structur Civil Engineering: Specialisation Geotech Civil Engineering: Specialisation Water a Civil Engineering: Specialisation Coastal Chemical and Bioprocess Engineering: To | nnical Engineering: Elective Compulsory nd Traffic: Compulsory Engineering: Elective Compulsory echnical Complementary Course: Elective Compulso | | Compulsory |
| Examination Examination duration and scale Assignment for the | 60 min (chemistry) + presentation Civil Engineering: Specialisation Structur Civil Engineering: Specialisation Geotech Civil Engineering: Specialisation Water a Civil Engineering: Specialisation Coastal Chemical and Bioprocess Engineering: Tr International Management and Engineer | nnical Engineering: Elective Compulsory nd Traffic: Compulsory Engineering: Elective Compulsory echnical Complementary Course: Elective Compulso ing: Specialisation II. Energy and Environmental Eng | ineering: Elective | Compulsory |
| Examination Examination duration and scale Assignment for the | 60 min (chemistry) + presentation Civil Engineering: Specialisation Structur Civil Engineering: Specialisation Geotech Civil Engineering: Specialisation Water a Civil Engineering: Specialisation Coastal Chemical and Bioprocess Engineering: Tr International Management and Engineer Process Engineering: Specialisation Envir | nnical Engineering: Elective Compulsory nd Traffic: Compulsory Engineering: Elective Compulsory echnical Complementary Course: Elective Compulso ing: Specialisation II. Energy and Environmental Eng ronmental Process Engineering: Elective Compulsor | ineering: Elective | Compulsory |
| Examination Examination duration and scale Assignment for the | 60 min (chemistry) + presentation Civil Engineering: Specialisation Structur Civil Engineering: Specialisation Geotech Civil Engineering: Specialisation Water a Civil Engineering: Specialisation Coastal Chemical and Bioprocess Engineering: Tr International Management and Engineer Process Engineering: Specialisation Envir Process Engineering: Specialisation Proc | nnical Engineering: Elective Compulsory nd Traffic: Compulsory Engineering: Elective Compulsory echnical Complementary Course: Elective Compulso ing: Specialisation II. Energy and Environmental Eng ronmental Process Engineering: Elective Compulsor ess Engineering: Elective Compulsory | ineering: Elective | Compulsory |
| Examination Examination duration and scale Assignment for the | 60 min (chemistry) + presentation Civil Engineering: Specialisation Structur Civil Engineering: Specialisation Geotech Civil Engineering: Specialisation Water a Civil Engineering: Specialisation Coastal Chemical and Bioprocess Engineering: Tr International Management and Engineer Process Engineering: Specialisation Envi Process Engineering: Specialisation Proc Water and Environmental Engineering: S | nnical Engineering: Elective Compulsory nd Traffic: Compulsory Engineering: Elective Compulsory echnical Complementary Course: Elective Compulso ing: Specialisation II. Energy and Environmental Eng ronmental Process Engineering: Elective Compulsor ess Engineering: Elective Compulsory | ineering: Elective | Compulsory |

| Course L0311: Chemistry of | Drinking Water Treatment |
|----------------------------|---|
| | Lecture |
| Hrs/wk | |
| CP | 1 |
| Workload in Hours | Independent Study Time 2, Study Time in Lecture 28 |
| Lecturer | Dr. Klaus Johannsen |
| Language | DE |
| Cycle | WiSe |
| Content | The topic of this course is water chemistry with respect to drinking water treatment and water distribution |
| | Major topics are solubility of gases, carbonic acid system and calcium carbonate, blending, softening, redox processes, materials and legal requirements on drinking water treatment. Focus is put on generally accepted rules of technology (DVGW- and DIN- standards). Special emphasis is put on calculations using realistic analysis data (e.g. calculation of pH or calcium carbonate dissolution potential) in exercises. Students can get a feedback and gain extra points for exam by solving problems for homework. Knowledge of drinking water treatment processes is vital for this lecture. Therefore the most important processes are explained coordinated with the course " Water resources management" in the beginning of the semester. |
| Literature | MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John Wiley & Sons, Hoboken, 2005. Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley & Sons, New York, 1996. DVGW (Hrsg.): Wasseraufbereitung - Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004. Jensen, J. N.: A Problem Solving Approach to Aquatic Chemistry. John Wiley & Sons, Inc., New York, 2003. |

| Course L0312: Chemistry of Drinking Water Treatment | | |
|---|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Dr. Klaus Johannsen | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L0402: Water Resour | ce Management |
|----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Mathias Ernst |
| Language | DE |
| Cycle | WiSe |
| Content | The lecture provides comprehensive knowledge on interaction of water ressource management and drinking water supply. Content |
| | overview: Current situation of global water resources User and Stakeholder conflicts Wasserressourcenmanagement in urbane Gebieten Rechtliche Aspekte, Organisationsformen Trinkwasserversorgungsunternehmen. Ökobilanzierung, Benchmarking in der Wasserversorgung |
| Literature | Aktuelle UN World Water Development Reports Branchenbild der deutschen Wasserwirtschaft, VKU (2011) Aktuelle Artikel wissenschaftlicher Zeitschriften Ppt der Vorlesung |

| Course L0403: Water Resour | urse L0403: Water Resource Management | | |
|----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 1 | | |
| СР | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Mathias Ernst | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | |
|--|--|---|
| Title Construction Robotics (L2867) | TypHrs/wkCPProject-/problem-based Learning66 | I |
| Module Responsible | Prof. Kay Smarsly | |
| Admission Requirements | None | |
| Recommended Previous | Basics of project-oriented programming | |
| Knowledge | | |
| - | After taking part successfully, students have reached the following learning results | |
| Professional Competence | | |
| Knowledge | Basics of robotics | |
| | Applications in civil engineering | |
| | Kinematics | |
| | | |
| Skills | Use of specific hardware | |
| | Development of software routines | |
| | Python programming language | |
| | | |
| | Image processing | |
| | Basics of localization (LIDAR, SLAM) | |
| Personal Competence | | |
| Social Competence | | |
| | | |
| | Communication skills | |
| Autonomy | Independent work | |
| | Independent decisions | |
| | | |
| | | |
| | | |
| | | |
| Examination | | |
| Examination duration and scale | ca. 10 Seiten | |
| | Civil Engineering: Specialisation Structural Engineering: Elective Compulsory | |
| - | | |
| | Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory | |
| | Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory | |
| | Civil Engineering: Specialisation Computational Engineering: Elective Compulsory | |
| | Computer Science: Specialisation II: Intelligence Engineering: Elective Compulsory | |
| | Mechatronics: Core Qualification: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Robotics and Computer Science: Elective Compulsory | |

| τνρ | Project-/problem-based Learning | |
|------------|--|--|
| Hrs/wk | | |
| CP | | |
| | Independent Study Time 96, Study Time in Lecture 84 | |
| | Prof. Kay Smarsly, Jan Stührenberg | |
| Language | | |
| Cycle | | |
| Content | Introduction: Robotics in civil engineering Presentation of potential topics Programming of algorithms in Python Application of software systems: LINUX distribution, ROS, CloudCompare, Application of hardware systems: Petoi Bittle Dog, Raspberry Pi, Arduino, sensing Topics considered for robotics using the Petoi Bittle Dog: Movement Use of sensors (camera, infrared,) Data structures/data acquisition Programming Topics technically relevant to building inspection: Geodetic evaluations Image processing Localization | |
| Literature | Bock/Linner: Construction Robotics | |
| | Verl et al.: Soft Robotics | |
| | Pasquale: New Laws of robotics | |

| Courses | | | | |
|----------------------------------|--|---|---------------------------|-------------|
| Title | | Тур | Hrs/wk | СР |
| Environmental Analysis (L0354) | | Lecture | 2 | 3 |
| Environmental microbiology (L322 | 3) | Lecture | 2 | 3 |
| Module Responsible | Dr. Dorothea Rechtenbach | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Fundamentals of inorganic/organic chemistry and biology (knowledge acquired at school). | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, studer | ts have reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | On completion of this module, students will be able to describe the mechanisms of biological systems. They will know the m biological metabolic routes and can categorise their influence on global metabolic routes. They will be familiar with the ba analytical methods for investigating and assessing the quality of various environmental compartments. | | | |
| Skills | On completion of this module, students will be able to categorise which metabolism will predominate under which environment conditions. Students will be able to apply the theoretical principles they have learnt to exemplary sites and assess the resulting relationshi from a technical and conceptual perspective. They will be able to draw comparisons on different investigation strategies a techniques. Model projects can be devised and treated. | | | |
| Personal Competence | | | | |
| Social Competence | The students are able to organize working processes within a team in a targeted way and based on the divison of labour. | | | |
| Autonomy | Students can independently exploit s | ources, acquire the particular knowledge of the s | ubject and apply it to ne | w problems. |
| Workload in Hours | Independent Study Time 124, Study | Time in Lecture 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and scale | 90 min | | | |
| | Civil Engineering: Specialisation Wat | ar and Traffic: Elective Compulsory | | |
| | | | | |

| Course L0354: Environmenta | l Analysis |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Dr. Dorothea Rechtenbach, Dr. Henning Mangels |
| Language | EN |
| Cycle | WiSe |
| Content | Introduction |
| | Sampling in different environmental compartments, sample transportation, sample storage |
| | Sample preparation |
| | Photometry |
| | Wastewater analysis |
| | Introduction into chromatography |
| | Gas chromatography |
| | HPLC |
| | Mass spectrometry |
| | Optical emission spectrometry |
| | Atom absorption spectrometry |
| | Quality assurance in environmental analysis |
| Literature | Roger Reeve, Introduction to Environmental Analysis, John Wiley & Sons Ltd., 2002 (TUB: USD-728) |
| | Pradyot Patnaik, Handbook of environmental analysis: chemical pollutants in air, water, soil, and solid wastes, CRC Press, Boca Raton, 2010 (TUB: USD-716) |
| | Chunlong Zhang, Fundamentals of Environmental Sampling and Analysis, John Wiley & Sons Ltd., Hoboken, New Jersey, 2007 (TUB: USD-741) |
| | Miroslav Radojević, Vladimir N. Bashkin, Practical Environmental Analysis RSC Publ., Cambridge, 2006 (TUB: USD-720) |
| | Werner Funk, Vera Dammann, Gerhild Donnevert, Sarah Iannelli (Translator), Eric Iannelli (Translator), Quality Assurance in Analytical Chemistry: Applications in Environmental, Food and Materials Analysis, Biotechnology, and Medical Engineering, 2nd Edition, WILEY-VCH Verlag GmbH & Co. KGaA,Weinheim, 2007 (TUB: CHF-350) |
| | STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, 21st Edition, Andrew D. Eaton, Leonore S. Clesceri, Eugene W. Rice, and Arnold E. Greenberg, editors, 2005 (TUB:CHF-428) |
| | K. Robards, P. R. Haddad, P. E. Jackson, Principles and Practice of Modern Chromatographic Methods, Academic Press |
| | G. Schwedt, Chromatographische Trennmethoden, Thieme Verlag |
| | H. M. McNair, J. M. Miller, Basic Gas Chromatography, Wiley |
| | W. Gottwald, GC für Anwender, VCH |
| | B. A. Bidlingmeyer, Practical HPLC Methodology and Applications, Wiley |
| | K. K. Unger, Handbuch der HPLC, GIT Verlag |
| | G. Aced, H. J. Möckel, Liquidchromatographie, VCH |
| | Charles B. Boss and Kenneth J. Fredeen, Concepts, Instrumentation and Techniques in Inductively Coupled Plasma Optical Emissio |
| | Spectrometry Perkin-Elmer Corporation 1997, On-line available at: http://files.instrument.com.cn/bbs/upfile/2006291448.pdf |
| | |
| | Atomic absorption spectrometry: theory, design and applications, ed. by S. J. Haswell 1991 (TUB: 2727-5614) |
| | Royal Society of Chemistry, Atomic absorption spectometry (http://www.kau.edu.sa/Files/130002/Files/6785_AAs.pdf) |

| Course L3223: Environmenta | ıl microbiology | |
|----------------------------|--|--|
| Тур | Lecture | |
| Hrs/wk | Hrs/wk 2 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | |
| Lecturer | Prof. Johannes Gescher | |
| Language | EN | |
| Cycle | WiSe | |
| Content | This lecture deals with the importance of microorganisms for biological material cycles and the health of water and soil. After the development of biochemical and cell biological basics, methods are presented that are necessary to investigate microbial communities and their activity. In addition, the role of microorganisms in the biogas process and in the biorefinery is discussed. The third part presents methods for purifying air, water and soil as well as environmentally friendly production processes involving microorganisms. | |
| Literature | Umweltmikrobiologie; Reineke, W. und Schlömann, M. (2015) 2. Aufl., Springer Spektrum Verlag Brock Mikrobiologie; Michael T. Madigan, Kelly S. Bender, Daniel H. Buckley, W. Matthew Sattley, David A. Stahl (2020) 15. Aufl., Pearson Studium Verlag | |

| Courses | | | | | |
|------------------------------------|--|---|------------------|-----------------|---------------------|
| Title | | Тур | | Hrs/wk | СР |
| Biological Wastewater Treatment (I | .0517) | Lecture | | 2 | 2 |
| Biological Wastewater Treatment (I | .3122) | Recitation Sect | ion (large) | 1 | 1 |
| Advanced Wastewater Treatment (| L0357) | Lecture | | 2 | 2 |
| Advanced Wastewater Treatment (| L0358) | Recitation Sect | ion (large) | 1 | 1 |
| Module Responsible | Dr. Joachim Behrendt | | | | |
| | None | | | | |
| | Knowledge of wastewater management a | nd the key processes involved in wast | ewater treatmen | t. | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students ha | ve reached the following learning res | ults | | |
| Professional Competence | | | | | |
| Knowledge | Students are able to outline key areas of | the full range of treatment systems ir | n waste water ma | anagement, as | well as their mut |
| | dependence for sustainable water protect | ion. They can describe relevant econo | omic, environmer | ntal and social | factors. |
| Skills | Students are able to pre-design and exp | ain the available wastewater treatme | ent processes ar | ud the scone o | f their application |
| SKIIS | municipal and for some industrial treatme | | ent processes un | ia the scope o | |
| | maneipar and for some madstrar creatine | | | | |
| Personal Competence | | | | | |
| Social Competence | Social skills are not targeted in this module. | | | | |
| 4 | Chudanta and in a paritien to work an a | autient and the annualize thesis would be | 9 in den en den | +l | |
| Autonomy | Students are in a position to work on a | subject and to organize their work i | now independen | tiy. They can | also present on ti |
| | subject. | | | | |
| Workload in Hours | Independent Study Time 96, Study Time i | Independent Study Time 96, Study Time in Lecture 84 | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and | 120 min | | | | |
| scale | | | | | |
| Assignment for the | Civil Engineering: Specialisation Structura | I Engineering: Elective Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechr | ical Engineering: Elective Compulsory | / | | |
| | Civil Engineering: Specialisation Coastal E | ngineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Water an | d Traffic: Compulsory | | | |
| | Bioprocess Engineering: Specialisation A - | , , , | | | |
| | Environmental Engineering: Specialisation | | | - | |
| | International Management and Engineerin | • • | - | | |
| | International Management and Engineerin | 5 1 5, | 5 | ering: Elective | Compulsory |
| | Process Engineering: Specialisation Enviro | • • | e Compulsory | | |
| | Process Engineering: Specialisation Proces | | | | |
| | Water and Environmental Engineering: Sp | | | | |
| | Water and Environmental Engineering: Sp | | mpulsory | | |
| | Water and Environmental Engineering: Sp | ecialisation Cities: Compulsory | | | |

| Course L0517: Biological Wastewater Treatment | | |
|---|---|--|
| Тур | Lecture | |
| Hrs/wk | | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Dr. Joachim Behrendt | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | Charaterisation of Wastewater | |
| | Metobolism of Microorganisms | |
| | Kinetic of mirobiotic processes | |
| | Calculation of bioreactor for wastewater treatment | |
| | Concepts of Wastewater treatment | |
| | Design of WWTP | |
| | Excursion to a WWTP | |
| | Biofilms | |
| | Biofim Reactors | |
| | Anaerobic Wastewater and sldge treatment | |
| | resources oriented sanitation technology | |
| | Future challenges of wastewater treatment | |
| Literature | Gujer, Willi | |
| | Siedlungswasserwirtschaft : mit 84 Tabellen | |
| | | |

| ISBN: 3540343296 (Gb.) URL: http://www.gbv.de/dms/bs/toc/516261924.pdf URL: http://deposit.d-nb.de/cgi-bin/dokserv? |
|--|
| id=2842122&prov=M&dok_var=1&dok_ext=htm |
| Berlin [u.a.] : Springer, 2007 |
| TUB_HH_Katalog |
| Henze, Mogens |
| Wastewater treatment : biological and chemical processes |
| ISBN: 3540422285 (Pp.) |
| Berlin [u.a.] : Springer, 2002 |
| TUB_HH_Katalog |
| Imhoff, Karl (Imhoff, Klaus R.;) |
| Taschenbuch der Stadtentwässerung : mit 10 Tafeln |
| ISBN: 3486263331 ((Gb.)) |
| München [u.a.] : Oldenbourg, 1999 |
| TUB_HH_Katalog |
| Lange, Jörg (Otterpohl, Ralf; Steger-Hartmann, Thomas;) |
| Abwasser : Handbuch zu einer zukunftsfähigen Wasserwirtschaft |
| ISBN: 3980350215 (kart.) URL: http://www.gbv.de/du/services/agi/52567E5D44DA0809C12570220050BF25/000000700334 |
| Donaueschingen-Pfohren : Mall-Beton-Verl., 2000 |
| TUB_HH_Katalog |
| Mudrack, Klaus (Kunst, Sabine;) |
| Biologie der Abwasserreinigung : 18 Tabellen |
| ISBN: 382741427X URL: http://www.gbv.de/du/services/agi/94B581161B6EC747C1256E3F005A8143/420000114903 |
| Heidelberg [u.a.] : Spektrum, Akad. Verl., 2003 |
| TUB_HH_Katalog |
| Tchobanoglous, George (Metcalf & Eddy, Inc., ;) |
| Wastewater engineering : treatment and reuse |
| ISBN: 0070418780 (alk. paper) ISBN: 0071122508 (ISE (*pbk)) |
| Boston [u.a.] : McGraw-Hill, 2003 |
| TUB_HH_Katalog |
| Henze, Mogens |
| Activated sludge models ASM1, ASM2, ASM2d and ASM3 |
| ISBN: 1900222248 |
| London : IWA Publ., 2002 |
| TUB_HH_Katalog |
| Kunz, Peter |
| Umwelt-Bioverfahrenstechnik |
| Vieweg, 1992 |
| Bauhaus-Universität., Arbeitsgruppe Weiterbildendes Studium Wasser und Umwelt (Deutsche Vereinigung für |
| Wasserwirtschaft, Abwasser und Abfall, ;) |
| Abwasserbehandlung : Gewässerbelastung, Bemessungsgrundlagen, Mechanische Verfahren, Biologische Verfahren, Reststoffe |
| aus der Abwasserbehandlung, Kleinkläranlagen |
| ISBN: 3860682725 URL: http://www.gbv.de/dms/weimar/toc/513989765_toc.pdf URL: |
| http://www.gbv.de/dms/weimar/abs/513989765_abs.pdf |
| Weimar : Universitätsverl, 2006 |
| TUB_HH_Katalog |
| Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall |
| DWA-Regelwerk |
| Hennef : DWA, 2004 |
| TUB_HH_Katalog |
| Wiesmann, Udo (Choi, In Su; Dombrowski, Eva-Maria;) |
| Fundamentals of biological wastewater treatment |
| ISBN: 3527312196 (Gb.) URL: http://deposit.ddb.de/cgi-bin/dokserv?id=2774611&prov=M&dok_var=1&dok_ext=htm |
| Weinheim : WILEY-VCH, 2007 |
| TUB_HH_Katalog |
| |

| Course L3122: Biological Wa | Course L3122: Biological Wastewater Treatment | |
|-----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dr. Joachim Behrendt | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L0357: Advanced Wa | stewater Treatment |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Joachim Behrendt |
| Language | EN |
| Cycle | SoSe |
| Content | Survey on advanced wastewater treatment |
| | reuse of reclaimed municipal wastewater |
| | Precipitation |
| | Flocculation |
| | Depth filtration |
| | Membrane Processes |
| | Activated carbon adsorption |
| | Ozonation |
| | "Advanced Oxidation Processes" |
| | Disinfection |
| Literature | Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003 |
| | Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987 |
| | Membranverfahren: Grundlagen der Modul- und Anlagenauslegung, T. Melin und R. Rautenbach, Springer-Verlag, Berlin 2007 |
| | Trinkwasserdesinfektion: Grundlagen, Verfahren, Anlagen, Geräte, Mikrobiologie, Chlorung, Ozonung, UV-Bestrahlung, |
| | Membranfiltration, Qualitätssicherung, W. Roeske, Oldenbourg-Verlag, München 2006 |
| | Organische Problemstoffe in Abwässern, H. Gulyas, GFEU, Hamburg 2003 |

| Course L0358: Advanced Was | stewater Treatment |
|----------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Dr. Joachim Behrendt |
| Language | EN |
| Cycle | SoSe |
| Content | Aggregate organic compounds (sum parameters) |
| | Industrial wastewater |
| | Processes for industrial wastewater treatment |
| | Precipitation |
| | Flocculation |
| | Activated carbon adsorption |
| | Recalcitrant organic compounds |
| | |
| Literature | Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003 |
| | Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987 |
| | Membranverfahren: Grundlagen der Modul- und Anlagenauslegung, T. Melin und R. Rautenbach, Springer-Verlag, Berlin 2007 |
| | Trinkwasserdesinfektion: Grundlagen, Verfahren, Anlagen, Geräte, Mikrobiologie, Chlorung, Ozonung, UV-Bestrahlung, Membranfiltration, Qualitätssicherung, W. Roeske, Oldenbourg-Verlag, München 2006 |
| | Organische Problemstoffe in Abwässern, H. Gulyas, GFEU, Hamburg 2003 |

| _ | | | | |
|---|---|--|-----------------|--------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Noise Protection (L1109) Urban Infrastructures (L0874) | | Lecture Project-/problem-based Learning | 2 2 | 2 |
| | Dr. Dorothea Rechtenbach | Hoject-/problem-based Learning | 2 | 7 |
| Admission Requirements | | | | |
| Recommended Previous | None | | | |
| Kecommended Previous Knowledge | Knowledge on Urban planning | | | |
| Kilowiedge | Knowledge on measures for climate protection | | | |
| | General knowledge of scientific writing/working | | | |
| Educational Objectives | After taking part successfully, students have reached the follo | wing learning results | | |
| Professional Competence | | | | |
| • | Students can describe urban development corridors as well a | s current and future urban environ | mental probler | ms. They are able |
| | explain the causes of environmental problems (like noise). | | | |
| | Students can specify applications for various technical innova | tions and explain why these contri | bute to the im | provement of url |
| | life. They can, for example, derive and discuss measures for effective noise abatement. | | | |
| Skille | | | problems of ur | |
| JKIIIS | Students are able to develop specific solutions for correcting existing or future environment-related problems of urba development. They can define a range of conceptual and technical solutions for environmental problems for different development. | | | |
| | paths. To solve specific urban environmental problems they | | | |
| | context. | | na megrate t | inem into the un |
| Personal Competence | | | | |
| • | The students can work together in international groups. | | | |
| | | | | |
| Autonomy | Students are able to organize their work flow to prepare then | | ributions to th | ne discussions. Tl |
| | can acquire appropriate knowledge by making enquiries indep | pendently. | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | Written Report plus oral Presentation | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Election | ve Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Ele | ective Compulsory | | |
| | Civil Engineering: Specialisation Coastal Engineering: Elective | | | |
| | Civil Engineering: Specialisation Water and Traffic: Elective Co | | | |
| | Environmental Engineering: Core Qualification: Elective Comp | • | | |
| | Joint European Master in Environmental Studies - Cities and Su | • | | |
| | Logistics, Infrastructure and Mobility: Specialisation Infrastruct | | ory | |
| | Water and Environmental Engineering, Creciplication Environment | erent. Elective Communication | | |
| | Water and Environmental Engineering: Specialisation Environ Water and Environmental Engineering: Specialisation Cities: C | | | |

| Course L1109: Noise Protect | Course L1109: Noise Protection | | |
|-----------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Martin Jäschke | | |
| Language | EN | | |
| Cycle | SoSe | | |
| Content | | | |
| Literature | 1) Müller & Möser (2013): Handbook of Engineering Acoustics (also available in German) | | |
| | 2) WHO (1999): Guidelines for Community Noise | | |
| | 3) Environmental Noise Directive 2002/49/EG | | |
| | 4) ISO 9613-2 (1996): Acoustics, Attenuation of sound during propagation outdoors, Part 2: General method of calculation | | |

| Course L0874: Urban Infrast | urse L0874: Urban Infrastructures | | |
|-----------------------------|---|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 2 | | |
| СР | 4 | | |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 | | |
| Lecturer | Dr. Dorothea Rechtenbach | | |
| Language | EN | | |
| Cycle | SoSe | | |
| Content | Problem Based Learning Main topics are: • Central vs. Decentral Wastewater Treatment. • Compaction of Cities. • Car Free Cities. • Multifunctional Places in Cities. • The Sustainability of Freight Transport in Cities. | | |
| Literature | Depends on chosen topic. | | |

| Courses | | | | |
|---------------------------------|--|---|-----------------------------|--------------------|
| Title | | Тур | Hrs/wk | СР |
| | ergy, Soil and Food Nexus (L1229) | Seminar | 2 | 2 |
| Water & Wastewater Systems in a | Global Context (L0939) | Lecture | 2 | 4 |
| Module Responsible | Prof. Ralf Otterpohl | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge of the global situation with | h rising poverty, soil degradation, mig | ration to cities, lack of | water resources a |
| Knowledge | sanitation | | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning results | | |
| Professional Competence | | | | |
| | Students can describe the facets of the globa | al water situation. Students can iudge the | e enormous potential of the | ne implementation |
| | synergistic systems in Water, Soil, Food and | | | |
| | | | | |
| Skills | Students are able to design ecological settle | ements for different geographic and soc | io-economic conditions f | or the main clima |
| | around the world. | | | |
| Personal Competence | | | | |
| | The students are able to develop a specific topic in a team and to work out milestones according to a given plan. | | | |
| ···· //··· | | | 5 - 5 - 1 | |
| Autonomy | Students are in a position to work on a subject and to organize their work flow independently. They can also present on | | | also present on th |
| | subject. | | | |
| 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 | During the course of the semester, the students work towards mile stones. The work includes presentations and papers. Detail | | | |
| scale | information can be found at the beginning of | the smester in the StudIP course module | e handbook. | |
| Assignment for the | Civil Engineering: Specialisation Water and T | raffic: Elective Compulsory | | |
| Following Curricula | Bioprocess Engineering: Specialisation A - Ge | eneral Bioprocess Engineering: Elective C | Compulsory | |
| | Chemical and Bioprocess Engineering: Specia | alisation General Process Engineering: El | ective Compulsory | |
| | Environmental Engineering: Core Qualification | n: Elective Compulsory | | |
| | Joint European Master in Environmental Stud | ies - Cities and Sustainability: Core Quali | fication: Compulsory | |
| | Process Engineering: Specialisation Environm | nental Process Engineering: Elective Com | ipulsory | |
| | Process Engineering: Specialisation Process I | Engineering: Elective Compulsory | | |
| | Water and Environmental Engineering: Speci | alisation Water: Elective Compulsory | | |
| | Water and Environmental Engineering: Speci | alisation Environment: Elective Compulse | ory | |
| | Water and Environmental Engineering: Speci | alisation Cities: Elective Compulsory | | |

| Course L1229: Ecological Tov | wn Design - Water, Energy, Soil and Food Nexus |
|------------------------------|--|
| Тур | Seminar |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Ralf Otterpohl |
| Language | EN |
| Cycle | SoSe |
| Content | Participants Workshop: Design of the most attractive productive Town Keynote lecture and video The limits of Urbanization / Green Cities The tragedy of the Rural: Soil degradation, agro chemical toxification, migration to cities Global Ecovillage Network: Upsides and Downsides around the World Visit of an Ecovillage Participants Workshop: Resources for thriving rural areas, Short presentations by participants, video competion TUHH Rural Development Toolbox Integrated New Town Development Participants workshop: Design of New Towns: Northern, Arid and Tropical cases Outreach: Participants campaign City with the Rural: Resilience, quality of live and productive biodiversity |
| Literature | Ralf Otterpohl 2013: Gründer-Gruppen als Lebensentwurf: "Synergistische Wertschöpfung in erweiterten Kleinstadt- und Dorfstrukturen", in "Regionales Zukunftsmanagement Band 7: Existenzgründung unter regionalökonomischer Perspektive, Pabst Publisher, Lengerich http://youtu.be/9hmkgn0nBgk (Miracle Water Village, India, Integrated Rainwater Harvesting, Water Efficiency, Reforestation and Sanitation) TEDx New Town Ralf Otterpohl: http://youtu.be/_M0J2u9BrbU |

| Course L0939: Water & Wast | Course L0939: Water & Wastewater Systems in a Global Context | | |
|----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 4 | | |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 | | |
| Lecturer | Prof. Ralf Otterpohl | | |
| Language | EN | | |
| Cycle | SoSe | | |
| Content | | | |
| | Keynote lecture and video Water & Soil: Water availability as a consequence of healthy soils Water and it's utilization, Integrated Urban Water Management Water & Energy, lecture and panel discussion pro and con for a specific big dam project Rainwater Harvesting on Catchment level, Holistic Planned Grazing, Multi-Use-Reforestation Sanitation and Reuse of water, nutrients and soil conditioners, Conventional and Innovative Approaches Why are there excreta in water? Public Health, Awareness Campaigns Rehearsal session, Q&A | | |
| Literature | Montgomery, David R. 2007: Dirt: The Erosion of Civilizations, University of California Press Liu, John D.: http://eempc.org/hope-in-a-changing_climate/ (Integrated regeneration of the Loess Plateau, China, and sites in Ethiopia and Rwanda) http://youtu.be/9hmkgn0nBgk (Miracle Water Village, India, Integrated Rainwater Harvesting, Water Efficiency, Reforestation and Sanitation) | | |

| Courses | |
|-----------------------------------|--|
| Fitle | Typ Hrs/wk CP |
| City Planning (L1066) | Project-/problem-based Learning 4 6 |
| Module Responsible | Prof. Carsten Gertz |
| Admission Requirements | None |
| Recommended Previous | for "Principles of Urban Planning": none |
| Knowledge | for "Designing Urban Streetscapes": some knowledge of transport planning, e.g. through taking the undergraduate class "Tra |
| | Planning and Traffic Engineering" |
| | |
| Educational Objectives | After taking part successfully, students have reached the following learning results |
| Professional Competence | |
| Knowledge | Students are able to: |
| | use technical terms of urban planning. |
| | describe the main determinants of urban development. |
| | explain and compare different possibilities of how urban development can be influenced. |
| | discuss requirements for public streetscapes. |
| | explain the importance of street design. |
| | |
| Skills | Students are able to: |
| | read and analyze urban development concepts and designs for streetscapes |
| | appraise such concepts in the context of competing requirements. |
| | design, justify and reflect their own solutions for concrete examples. |
| | |
| Personal Competence | |
| Social Competence | Students are able to: |
| | discuss intermediate results with each other. |
| | constructively accept feedback on their own work. |
| | provide constructive feedback to others. |
| | |
| Autonomy | Students are able to: |
| | independently complete a written report including drawings following a broadly pre-defined process. |
| | assess the consequences of their proposed solutions. |
| | independently acquire knowledge and apply this to new issues or problem areas. |
| | |
| | Independent Study Time 124, Study Time in Lecture 56 |
| Credit points | |
| Course achievement Examination | |
| Examination duration and | |
| scale | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Elective Compulsory |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory |
| | Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory |
| | Civil Engineering: Specialisation Water and Traffic: Elective Compulsory |
| | Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective Compulsory |
| | Water and Environmental Engineering: Specialisation Environment: Elective Compulsory |

| Course L1066: City Planning | |
|-----------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| СР | 6 |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Lecturer | Prof. Carsten Gertz |
| Language | DE |
| Cycle | SoSe |
| Content | "Principles of Urban Planning" deals with the determinants of urban development and their interactions. Topics include: |
| | legal framework, instruments and methods of planning, functional requirements, stakeholders and actors basic design requirements different planning levels and historical contexts. The objective of the course is for students to acquire a basic understanding of urban development problems and approaches for solving them. They will also be able to comprehend the process of urban planning. The course also covers the various functional and aesthetic requirements for designing streetscape as the most important elements of public space. The project work deals with a real life scenario and includes drawing up a development plan, an urban design concept, a building masterplan and a street redesign. |
| Literature | Albers, Gerd; Wekel, Julian (2021) Stadtplanung: Eine illustrierte Einführung. 4. überarbeitete Auflage. Primus Verlag. Darmstadt. Frick, Dieter (2011) Theorie des Städtebaus: Zur baulich-räumlichen Organisation von Stadt. 3. veränderte Auflage. Wasmuth- Verlag. Tübingen Jonas, Carsten (2009) Die Stadt und ihr Grundriss. Wasmuth-Verlag. Tübingen Kostof, Spiro; Castillo, Greg (1998) Die Anatomie der Stadt. Geschichte städtischer Strukturen. Campus-Verlag. Frankfurt/New York. |

| - | | | | |
|---------------------------------|--|-----------------------------|---------------|----------------------|
| Courses | | | | |
| Title | Тур | | Hrs/wk | СР |
| Construction Logistics (L1163) | Lectu | re | 1 | 2 |
| Construction Logistics (L1164) | | ation Section (small) | 1 | 2 |
| Project Development and Managen | | | 1 | 1 |
| Project Development and Managen | | ct-/problem-based Learning | 1 | 1 |
| Module Responsible | Prof. Heike Flämig | | | |
| Admission Requirements | None | | | |
| Recommended Previous | none | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the following lea | rning results | | |
| Professional Competence | | | | |
| Knowledge | Students can | | | |
| | | | | |
| | give definitions of the main terms of construction logistics and p | | anagement | |
| | name advantages and disadvantages of internal or external con | | | |
| | explain characteristics of products, demand and production of of | construction objects and th | eir consequer | nces for constructio |
| | specific supply chains | | | |
| | differentiate constructions logistics from other logistics systems | | | |
| Skills | Students can | | | |
| | | | | |
| | carry out project life cycle assessments | | | |
| | apply methods and instruments of construction logistics | | | |
| | apply methods and instruments of project development and ma | nagement | | |
| | apply methods and instruments of conflict management | | | |
| | design supply and waste removal concepts for a construction pr | oject | | |
| Personal Competence | | | | |
| Social Competence | Students con | | | |
| Social Competence | | | | |
| | hold presentations in and for groups | | | |
| | apply methods of conflict solving skills in group work and case s | tudies | | |
| | | | | |
| Autonomy | Students can | | | |
| | solve problems by holistic, systemic and flow oriented thinking | | | |
| | improve their creativity, negotiation skills, conflict and crises | solution skills by applying | methods of | moderation in cas |
| | studies | | | |
| | | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | Two written papers with presentations | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Elective Comp | ulsory | | |
| Following Curricula | | | | |
| 5 | Civil Engineering: Specialisation Coastal Engineering: Elective Compute | | | |
| | Civil Engineering: Specialisation Water and Traffic: Elective Compulsor | • | | |
| | International Management and Engineering: Specialisation II. Civil Engi | | ory | |
| | International Management and Engineering: Specialisation II. Logistics | | - | |
| | incernational Management and Engineering. Specialisation II. Logistics | | | |
| | Logistics, Infrastructure and Mobility: Specialisation Production and Log | | / | |

| ourse L1163: Construction | Logistics |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Heike Flämig |
| Language | DE |
| Cycle | SoSe |
| Content | The lecture gives deeper insight how important logistics are as a competetive factor for construction projects and which issues are to be adressed. The following toppics are covered: • competetive factor logistics • the concept of systems, planning and coordination of logistics • the concept of systems, planning and coordination of logistics • material, equipment and reverse logistics • IT in construction logistics • elements of the planning model of construction logistics and their connections • flow oriented logistics systems for construction projects • logistics concepts for ready to use construction projects (especially procurement and waste removel logistics) • best practice examples (construction logistics Potsdamer Platz, recent case study of the region) Contents of the lecture are deepened in special exercises. |
| Literature | Flämig, Heike: Produktionslogistik in Stadtregionen. In: Forschungsverbund Ökologische Mobilität (Hrsg.) Forschungsbericht Bd 15.2. Wuppertal 2000. Krauss, Siri: Die Baulogistik in der schlüsselfertigen Ausführung, Bauwerk Verlag GmbH Berlin 2005. Lipsmeier, Klaus: Abfallkennzahlen für Neubauleistungen im Hochbau : Verlag Forum für Abfallwirtschaft und Altlasten, 2004. Schmidt, Norbert: Wettbewerbsfaktor Baulogistik. Neue Wertschöpfungspotenziale in der Baustoffversorgung. In: Klaus, Peter Edition Logistik. Band 6. Deutscher Verkehrs-Verlag. Hamburg 2003. Seemann, Y.F. (2007): Logistikkoordination als Organisationseinheit bei der Bauausführung Wissenschaftsverlag Mainz in Aachen, Aachen. (Mitteilungen aus dem Fachgebiet Baubetrieb und Bauwirtschaft (Hrsg. Kuhne, V.): Heft 20) |

| Course L1164: Construction | ourse L1164: Construction Logistics | |
|----------------------------|---|--|
| Тур | Recitation Section (small) | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Heike Flämig | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| ourse L1161: Project Development and Management | |
|---|---|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Heike Flämig, Dr. Anton Worobei |
| Language | DE |
| Cycle | SoSe |
| Content | Within the lecture, the main aspects of project development and management are tought: |
| | Terms and definitions of project management Advantages and disadvantages of different ways of project handling organization, information, coordination and documentation cost and fincance management in projects time- and capacity management in projects specific methods and instruments for successful team work Contents of the lecture are deepened in special exercises. |
| Literature | Projektmanagement-Fachmann. Band 1 und Band 2. RKW-Verlag, Eschborn, 2004. |

| ourse L1162: Project Development and Management | |
|---|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Heike Flämig, Dr. Anton Worobei |
| Language | DE |
| Cycle | SoSe |
| Content | See interlocking course |
| Literature | See interlocking course |

Module M0593: Building Materials and Building Preservation

| Courses | | | | | | |
|-------------------------------------|---|---|-------------------------------|------------------------|--------------|--------------------|
| Title | | | Тур | | Hrs/wk | СР |
| Repair of Structures (L0255) | | | Lecture | | 1 | 1 |
| Mineral Building Materials (L0253) | | | Lecture | | 2 | 2 |
| Technology of mineral Building Mat | erials (L0256) | | Project-/p | problem-based Learning | 1 | 2 |
| Transport Processes in Building Mat | erials and Damage Proce | sses (L0254) | Lecture | | 1 | 1 |
| Module Responsible | Prof. Frank Schmidt-Dö | ihl | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Basic knowledge about | it building materials, b | uilding physics and buildin | g chemistry, for exam | ple by the m | nodules Principles |
| Knowledge | Building Materials and | Building Physics and Bu | ilding Materials and Building | g Chemistry. | | |
| Educational Objectives | After taking part succe | ssfully, students have r | eached the following learnin | ig results | | |
| Professional Competence | | | | | | |
| Knowledge | The students are able to describe the components of mineral building materials and their function in detail and to use them for the manufacture of special mineral building materials. They are able to show the characteristics of mineral building materials. They a able to describe the manufacture, properties and fields of application of special mortars and special concretes and the correlation of their material parameters. They are able to show the principles of anchor technology and design. | | | | | |
| Skills | The students are able to perform an optimization of granulometry of a mineral building material. They are able to design a spec mineral mortar and to manufacture this mortar. The students are able to manufacture post installed rebar connections. They a able to recognize damages, to assess possible causes, to use the fundamentals of construction preservation and to select repr and strengthening measures. | | | | | |
| Personal Competence | | | | | | |
| Social Competence | The students are able to develop in small grous the mixture of a special mortar. They present their results to the lecturer and the other students. In a critical discussion they defend and adjust their results. The students are able to manufacture their spect building material on the basis of this feedback. | | | | | |
| Autonomy | The students are able to responsibly use the resources of materials and lab equipment for their project and to investigate and to get missing components. | | | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | | | |
| Credit points | 6 | | | | | |
| Course achievement | CompulsoryBonusYes20 % | Form Subject theoretical practical work | Description and | | | |
| Examination | Written exam | | | | | |
| Examination duration and scale | 120 min | | | | | |
| | Civil Engineering: Spec | ialisation Geotechnical | Engineering: Compulsory | | | |
| Following Curricula | | | eering: Elective Compulsory | , | | |
| i onowing curricula | | | | | | |
| | Civil Engineering, Spec | vialisation Structural Env | gineering: Elective Compulso | אראר | | |

| Course L0255: Repair of Structures | |
|------------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Frank Schmidt-Döhl |
| Language | DE |
| Cycle | SoSe |
| Content | Maintenance of structures, repair and strengthening, subsequent waterproofing of structures |
| Literature | BetonMarketing Deutschland (Hrsg.): Stahlbetonoberflächen - schützen, erhalten, instandsetzen |

| Course L0253: Mineral Buildi | Course L0253: Mineral Building Materials | |
|------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Frank Schmidt-Döhl | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Components of mineral building materials and their function, binding materials, concrete and mortar, special mortars, special | |
| | concretes | |
| Literature | Taylor, H.F.W.: Cement Chemistry | |
| | Springenschmid, R.: Betontechnologie für die Praxis | |

| Course L0256: Technology of | Course L0256: Technology of mineral Building Materials | |
|-----------------------------|--|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 1 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | |
| Lecturer | Prof. Frank Schmidt-Döhl | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Design and production of a special mineral building material | |
| Literature | Taylor, H.F.W.: Cement Chemistry | |
| | Springenschmid, R.: Betontechnologie für die Praxis | |

| Course L0254: Transport Processes in Building Materials and Damage Processes | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Frank Schmidt-Döhl | |
| Language | DE | |
| Cycle | SoSe | |
| Content | Transport Processes in Building Materials and Damage Processes | |
| Literature | Blaich, J.: Bauschäden, Analyse und Vermeidung | |

| Courses | | | | | |
|-----------------------------------|--|--|--------------------|--------------------|--|
| Title | | Тур | Hrs/wk | СР | |
| Structural Dynamics (L1202) | | Lecture | 2 | 2 | |
| Structural Dynamics (L1203) | | Recitation Section (large) | 2 | 2 | |
| Fracture mechanics and fatigue in | steel structures (L0564) | Lecture | 1 | 1 | |
| Fracture mechanics and fatigue in | steel structures (L0565) | Recitation Section (large) | 1 | 1 | |
| Module Responsible | Prof. Bastian Oesterle | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Knowledge of linear structural analysis | of statically determinate and indeterminate struct | tures; Mechanics | I/II, Mathematics | |
| Knowledge | Differential equations I | | | | |
| Educational Objectives | After taking part successfully, students h | nave reached the following learning results | | | |
| Professional Competence | Arter taking part successiony, students i | lave reached the following learning results | | | |
| • | After successful completion of this may | tule the student can explain the basic aspects of | dunamia offacta a | an atructures and | |
| Kilowiedge | respective methods. | lule, the student can explain the basic aspects of o | | on scructures and | |
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| Skills | | odule, the students will be able to predict the re | sponse of mater | ial and structures | |
| | dynamics loading using the appropriate computational approaches and methods. | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| Personal Competence | | | | | |
| Social Competence | Students can | | | | |
| | participate in subject specific and | interdisciplingry discussions | | | |
| | participate in subject-specific and interdisciplinary discussions, | | | | |
| | defend their own work results in front of others promote the scientific development of colleagues | | | | |
| | | • | | | |
| | Furthermore, they can give and a | ccept professional constructive criticism | | | |
| Autonomy | Students are able to gain knowledge of | the subject area from given and other sources and a | apply it to new pr | oblems. Furthermo | |
| | they are able to structure the solution process for problems in the area of Structural Analysis. | | | | |
| | | | | | |
| Workload in Hours | Independent Study Time 96, Study Time | in Lecture 84 | | | |
| Credit points | 6 | | | | |
| Course achievement | | | | | |
| Examination | | | | | |
| Examination duration and | 150 min | | | | |
| scale | | | | | |
| Assignment for the | Civil Engineering: Specialisation Structur | ral Engineering: Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Geotech | nnical Engineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Coastal | Engineering: Elective Compulsory | | | |
| | Civil Engineering: Specialisation Water a | nd Traffic: Elective Compulsory | | | |
| | | | | | |
| | Civil Engineering: Specialisation Comput | ational Engineering: Elective Compulsory | | | |

| Course L1202: Structural Dy | namics | |
|-----------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| CP | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Bastian Oesterle | |
| Language | DE | |
| Cycle | SoSe | |
| Content | mechanical background of dynamics harmonic vibrations, damped and undamped free and forced vibrations frequency and time domain modelling aspects principle of d'Alembert systems with multiple degrees of freedom consistent and lumped mass matrices finite elements for dynamics problems impact problems eigenvalue problems and modal analysis direct time integration schemes, transient analyses | |
| Literature | Vorlesungsmanuskript Clough, R.W., Penzien, J.: Dynamics of Structures. 2. Aufl., McGraw-Hill, New York, 1993. | |

| Course L1203: Structural Dy | ourse L1203: Structural Dynamics | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Bastian Oesterle | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Workload in Hours Lecturer | Independent Study Time 16, Study Time in Lecture 14 |
|-------------------------------|--|
| Lecturer | |
| | Dr. Jürgen Priebe |
| Language | |
| | DE |
| Cycle | SoSe |
| Content | basics of fatigue stress and fatigue resistance and determination of fatigue strength, |
| | determination and use of S-N-curves and classification of notch effects, |
| | • set up of determination of fatigue strength under dynamic load using the accumulation formula by Palmgren-Miner, |
| | set up of determination of fatigue strength in different examples, |
| | basics of construction and design regarding the problem of material fatigue, |
| | basics of linear elastic fracture mechanics under static and dynamic load, |
| | determination of lifetime of steel construction based on linear elastic fracture mechanics in different examples. |
| Literature | Seeßelberg, C.; Kranbahnen - Bemessung und konstruktive Gestaltung; 3. Auflage; Bauwerk-Verlag; Berlin 2009 |
| | Kuhlmann, Dürr, Günther; Kranbahnen und Betriebsfestigkeit; in Stahlbau Kalender 2003; Verlag Ernst & Sohn; Berlin 2003 |
| | Deutscher Stahlbau-Verband (Hrsg.); Stahlbau Handbuch Band 1 Teil B; 3. Auflage; Stahlbau-Verlagsgesellschaft; Köln 199 |
| | Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993 |
| | DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsreg Bemessungsregeln f ür den Hochbau; 1993 |
| | • DIN V ENV 1993-6: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 6: Kranbahnen; 2001 |
| | • DIN-Fachbericht 126. Richtlinie zur Anwendung von DIN V ENV 1993-6; Nationales Anwendungsdokument (NAD); Berlin 20 |
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| Course L0565: Fracture mechanics and fatigue in steel structures | | |
|--|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Dr. Jürgen Priebe | |
| Language | DE | |
| Cycle | SoSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Module M0982: Trans | portation Modelling | | |
|-------------------------------------|--|---------------|---------------------|
| Courses | | | |
| Title | Тур | Hrs/wk | СР |
| Transportation Modelling (L1180) | Project-/problem-based Learning | 4 | 6 |
| Module Responsible | Prof. Carsten Gertz | | |
| Admission Requirements | None | | |
| Recommended Previous | some knowledge of transport planning, e.g. through taking the undergraduate class "Transport P | lanning and T | Traffic Engineering |
| Knowledge | | | |
| Educational Objectives | After taking part successfully, students have reached the following learning results | | |
| Professional Competence | | | |
| Knowledge | Students are able to understand the operation and potential applications of transport models. | | |
| Skille | Students are able to: | | |
| JKIII5 | | | |
| | use travel demand modelling software packages for solving practical problems. | | |
| | design a database structure for travel demand models. | | |
| | assess modelling results. | | |
| | appraise potential applications and limitations of such models. | | |
| | Students are able to independently develop and document solutions. Students are able to: independently organise, manage and solve set tasks. independently prepare written reports. | | |
| Werklood in Hours | Jadenandent Study Time 124, Study Time in Lecture 56 | | |
| | Independent Study Time 124, Study Time in Lecture 56 | | |
| Credit points Course achievement | | | |
| | | | |
| | Written elaboration | | |
| examination duration and scale | written assignment with presentation during the semester | | |
| | Civil Engineering: Specialisation Water and Traffic: Compulsory | | |
| - | Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective Compuls | 00/ | |
| Following Curricula | Water and Environmental Engineering: Specialisation Cities: Elective Compulsory | ory | |

| Course L1180: Transportation Modelling | | | |
|--|---|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | | | |
| СР | 5 | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | |
| Lecturer | Prof. Carsten Gertz | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | Principles of transport modelling Role of transport modelling in the planning process Fundamentals of mobility behaviour Design and evaluation of transport/mobility surveys mode of operation and data requirements for different stages of modelling Forecasting and scenarios in the transport planning The range of model applications (from transport infrastructure planning over simulation of traffic flows to integrated land-use and transport models as well as the use of models for evaluating locations) Practice-oriented project for assessing consequences of infrastructure projects and changes in land-use | | |
| Literature | Lohse, Dieter und Schnabel, Werner (2011): Grundlagen der Straßenverkehrstechnik und der Verkehrsplanung – Band 2. 3. Auflage. Beuth. Ortúzar, Juan de Dios und Willumsen, Luis G. (2011): Modelling Transport. 4. Auflage. John Wiley & Sons. | | |

| Module M0827: Mode | ling in Water Management | | | | | |
|----------------------------------|--|---|---------------|----------------------|--|--|
| Courses | | | | | | |
| Title | | Тур | Hrs/wk | СР | | |
| Groundwater Modeling using Modfl | ow (L0543) | Lecture | 1 | 1 | | |
| Groundwater Modeling using Modfl | | Recitation Section (small) | 2 | 2 | | |
| Modeling of Water Supply Network | | Project-/problem-based Learning | 2 | 3 | | |
| Module Responsible | | | | | | |
| Admission Requirements | | | | | | |
| Recommended Previous | Groundwater | | | | | |
| Knowledge | • groundwater hydraulics and transport of su | ubstances | | | | |
| | Pipe Systems | | | | | |
| | Knowledge on urban water infrastructure | es, in particular drinking water systemsand ι | ırban drainag | je systems includin | | |
| | special structures | | | | | |
| | Hydraulics of drinking water supply system | is and sewer systems | | | | |
| | Basic knowledge on water management | Basic knowledge on water management | | | | |
| Educational Objectives | After taking part successfully, students have read | hed the following learning results | | | | |
| Professional Competence | | | | | | |
| Knowledge | The students are able to describe the modelling of | f groundwater flow and transport as well as urb | an water infr | astructures. They ca | | |
| | carry out systems analyses and can detect technical and conceptual weak points within the systems in case studies. Besides the | | | | | |
| | are able to analyse interdependencies of hydraulic and toxic phenomena in soil and water. | | | | | |
| | | | | | | |
| | | | | | | |
| Skills | The students are able to construct and apply scientific groundwater models indipendently. They can work on different scenarios | | | | | |
| | and can compare or assess different solutions for existing problems by application of selected software products. The students are | | | | | |
| | able to use different software solutions (e.g. EPANET, EPA-SWMM). | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Personal Competence | | | | | | |
| Social Competence | Wird nicht vermittelt. | | | | | |
| Autonomy | Wird nicht vermittelt. | | | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecto | ure 70 | | | | |
| Credit points | | | | | | |
| Course achievement | None | | | | | |
| Examination | Oral exam | | | | | |
| Examination duration and | 30 min | | | | | |
| scale | | | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engine | eering: Elective Compulsory | | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Eng | jineering: Elective Compulsory | | | | |
| | Civil Engineering: Specialisation Coastal Engineer | ing: Elective Compulsory | | | | |
| | Civil Engineering: Specialisation Water and Traffic | : Elective Compulsory | | | | |
| | Civil Engineering: Specialisation Computational E | | | | | |
| | Water and Environmental Engineering: Specialisa | | | | | |
| | Water and Environmental Engineering: Specialisa | | | | | |
| | Water and Environmental Engineering: Specialisa | tion water: Elective Compulsory | | | | |

| Course L0543: Groundwater | Modeling using Modflow |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Sonja Götz |
| Language | DE/EN |
| Cycle | SoSe |
| Content | Introduction and application of the groundwater model MODFLOW (PMWIN); theoretical backround of the modell, students do work |
| | with the model PMWIN for practical case studies. |
| Literature | MODFLOW-Handbuch |
| | Chiang, Wen Hsien: PMWIN |
| | |

| Course L0544: Groundwater | rse L0544: Groundwater Modeling using Modflow | | |
|---------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Sonja Götz | | |
| Language | DE/EN | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Course L0875: Modeling of W | ourse L0875: Modeling of Water Supply Network | | |
|-----------------------------|--|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Dr. Klaus Johannsen | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | | | |
| Literature | Mutschmann/Stimmelmayr: Taschenbuch der Wasserversorgung, 16. Auflage. Springer Vieweg - Verlag. Wiesbaden 2014. | | |

| Courses | | | | |
|---|--|--|-------------------|----------------------|
| Title | | Тур | Hrs/wk | СР |
| Modelling of Flow in Rivers and Est | | Lecture | 3 | 4 |
| | ring / Integrated Flood Protection (L0961) | Project-/problem-based Learnir | g 2 | 2 |
| Module Responsible | | | | |
| Admission Requirements | | | | |
| | Fundamentals of Hydromechanics, Hydraulics, | Hydrology and Hydraulic Engineering; Hyd | draulic Engineer | ring I and Hydrau |
| Knowledge | Engineering II | | | |
| Educational Objectives | After taking part successfully, students have rea | ched the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to define in detail the basic processes that are related to the modelling of flows in hydraulic enginee Besides, they can describe the basic aspects of numerical modelling and actual numerical models for the simulation of flows | | | |
| | | - | odels for the sir | nulation of nows a |
| | waves. They can also depict the concepts of nature oriented hydraulic engineering. | | | |
| Skills Students are able to apply hydrodynamic-numerical models to practical hydraulic engineering tasks. | | | | ore, the students |
| | able to set up flood-risk management concepts and are able to apply basic concepts of renaturation to practical prob | | | |
| Personal Competence | | | | |
| | The students are able to deploy their gained kn | owledge in applied problems of the practical | natura bacad b | vdraulic opginoori |
| Social Competence | Additionaly, they will be able to work in team wit | | nature-based n | yuraulic eligilleeli |
| Autonomy | The students will be able to independently exten | • | | |
| Autonomy | The students will be able to independently exten | in their knowledge and apply it to new problem | 115. | |
| Workload in Hours | Independent Study Time 110, Study Time in Lect | ture 70 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | The duration of the examination is 150 min. T | he examination includes tasks with respect | to the general | understanding of |
| scale | lecture contents and calculations tasks. | | | |
| Assignment for the | Civil Engineering: Specialisation Water and Traff | c: Compulsory | | |
| Following Curricula | Environmental Engineering: Core Qualification: E | lective Compulsory | | |
| | Joint European Master in Environmental Studies | - Cities and Sustainability: Core Qualification: | Compulsory | |
| | Water and Environmental Engineering: Specialisa | ation Water: Compulsory | | |
| | Water and Environmental Engineering: Specialisa | ation Environment: Compulsory | | |
| | Water and Environmental Engineering: Specialisa | | | |

| Course L0810: Modelling of | Flow in Rivers and Estuaries |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | |
| CP | 4 |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 |
| Lecturer | Prof. Edgar Nehlsen, Prof. Peter Fröhle |
| Language | EN |
| Cycle | SoSe |
| Content | Introduction to numerical flow modelling |
| | Processes affecting tht flow Examples and applications of numerical models Procedure of numerical modelling Model concept Basic equations of hydrodynamics |
| | Saint-Venant equations |
| | Euler Equations |
| | Navier-Stokes equations Revealds averaged Navier Stokes equations |
| | Reynolds-averaged Navier-Stokes equations Shallow water equations |
| | |
| | Solving schemes |
| | Numerical discretization |
| | Solution algorithms |
| | Convergence |
| | |
| | |
| Literature | Vorlesungsskript |
| | Literaturempfehlungen |
| | |
| | |
| | Bund der Ingenieure für Wasserwirtschaft, Abfallwirtschaft und Kulturbau (1997): Hydraulische Berechnung von naturnahen Fließgewässern. Düsseldorf: BWK (BWK-Merkblatt). |
| | Chow, Ven-te (1959): Open-channel Hydraulics. New York usw.: McGraw-Hill (McGraw-Hill Civil Engineering Series). |
| | Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (DWA); DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische Modelle, DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische (2019a): Merkblatt DWA-M 543-2 Geodaten in der Fließgewässermodellierung Teil 1: Geodaten in der Fließgewässermodellierung. Februar 2019. Hennef: Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall (DWA-Regelwerk, 543-1). |
| | Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (DWA); DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische Modelle, DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische (2019b): Merkblatt DWA-M 543-2 Geodaten in der Fließgewässermodellierung Teil 2: Bedarfsgerechte Datenerfassung und -aufbereitung. Februar 2019. Hennef: Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall (DWA-Regelwerk, 543-2). |
| | Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (DWA); DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische Modelle, DWA-Arbeitsgruppe WW-3.2 Mehrdimensionale numerische (2019c): Merkblatt DWA-M 543-3 Geodaten in der Fließgewässermodellierung - Teil 3: Aspekte der Strömungsmodellierung und Fallbeispiele. Februar 2019. Hennef: Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall (DWA-Regelwerk, 543-3). |
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| | IAHR (2015): Professional Specifications for Physical and Numerical Studies in Environmental Hydraulics. In: Hydrolink (3/2015), S. 90-92. |
| | Olsen, Nils Reidar B. (2012): Numerical Modelling and Hydraulics. 3. Aufl. Department of Hydraulic and Environmental Engineering, The Norwegian University of Science and Technology. |
| | Szymkiewicz, Romuald (2010): Numerical modeling in open channel hydraulics. Dordrecht: Springer (Water science and technology library, 83). |
| | van Waveren, Harold (1999-): Good modelling practice handbook. [Utrecht], Lelystad, Den Haag: STOWA; Rijkswaterstaat-RIZA; SDU, afd. SEO/RIZA [etc. distr.] (Nota, nr. 99.036). |
| | Zielke, Werner (Hg.) (1999): Numerische Modelle von Flüssen, Seen und Küstengewässern. Deutscher Verband für Wasserwirtschaft und Kulturbau. Bonn: Wirtschafts- und VerlGes. Gas und Wasser (Schriftenreihe des Deutschen Verbandes für Wasserwirtschaft und Kulturbau, 127). |

| Course L0961: Nature-Orient | ted Hydraulic Engineering / Integrated Flood Protection |
|-----------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Natasa Manojlovic, Prof. Peter Fröhle |
| Language | DE/EN |
| Cycle | SoSe |
| Content | Regime-Theory and application for the development of environmental guiding priciples of rivers Engineering - biological measures for the stabilization of rivers Risk management in flood protection Design techniques in technical flood protection Methods for the assessment of flood caused damages |
| Literature | Vorlesungsumdruck |

| Courses | | | | | |
|-------------------------------------|--|---|---------------|------------------|--|
| Title | | Тур | Hrs/wk | СР | |
| Harbour Engineering (L0809) | | Lecture | 2 | 2 | |
| Harbour Engineering (L1414) | | Project-/problem-based Learning | 1 | 2 | |
| Port Planning and Port Construction | n (L0378) | Lecture | 2 | 2 | |
| Module Responsible | Prof. Peter Fröhle | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Basics of coastal engineering | | | | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students have reached the for | ollowing learning results | | | |
| Professional Competence | | | | | |
| Knowledge | The students are able to define in details and to choose design approaches for the functional design of a port and apply the | | | | |
| | design tasks. They can design the fundamental elements of a port. | | | | |
| Cl://- | | | | | |
| SKIIIS | The students are able to select and apply appropriate approaches for the functional design of ports. | | | | |
| Personal Competence | | | | | |
| Social Competence | The students are able to deploy their gained knowledge in applied problems such as the functional design of ports. Additiona | | | | |
| | they will be able to work in team with engineers of other disciplines. | | | | |
| Autonomy | The students will be able to independently extend their knowledge and apply it to new problems. | | | | |
| Workload in Hours | Independent Study Time 110, Study Time in Lecture 70 | | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Written exam | | | | |
| Examination duration and | The duration of the examination is 150 min. The examin | ation includes tasks with respect to | the general u | understanding of | |
| scale | lecture contents and calculations tasks. | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineering: Ele | ctive Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory | | | | |
| | Civil Engineering: Specialisation Coastal Engineering: Comp | oulsory | | | |
| | Civil Engineering: Specialisation Water and Traffic: Elective | Compulsory | | | |
| | International Management and Engineering: Specialisation | II. Civil Engineering: Elective Compuls | orv | | |

| | neering |
|-------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Peter Fröhle |
| Language | DE |
| Cycle | SoSe |
| Content | Fundamentals of harbor engineering Maritime transportation and waterways engineering Ships Elements of harbors Harbor approaches and water-side harbor areas Terminal design and handling of cargo Quay-walls and piers Equipment of harbors Sluices and other special constructions Connection to inland transportation / inland waterway transportation Protection of harbors Breakwaters and Jetties Wave protection of harbors Fishery and other small harbors |
| Literature | Brinkmann, B.: Seehäfen, Springer 2005 |

| Course L1414: Harbour Engi | ourse L1414: Harbour Engineering | | |
|----------------------------|---|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 1 | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Prof. Peter Fröhle | | |
| Language | DE | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Тур | Lecture |
|-------------------|---|
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Frank Feindt |
| Language | DE |
| Cycle | SoSe |
| Content | Planning and implementation of major projects Market analysis and traffic relations Planning process and plan Port planning in urban neighborhood Development of the logistics center "Port of Hamburg" in the metropolis Quays and waterfront structure Special planning Law Harbor - securing of a flexible use of the port Dimensioning of quays Flood protection structures Port of Hamburg - Infrastructure and development Preparation of areas Scour formation in front of shore structures |
| Literature | Vorlesungsumdruck, s. www.tu-harburg.de/gbt |

| Courses | | | | |
|--|---|---|------------------|--------------------|
| | | | 11 | |
| Title Water and Environment (L2754) | | Typ Project-/problem-based Learning | Hrs/wk 3 | CP 3 |
| Water and Environment (L2753) | | Lecture | 3 | 3 |
| Module Responsible | Prof. Nima Shokri | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge in water and environmental research, Hydrology | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached the follow | wing learning results | | |
| Professional Competence | | | | |
| Knowledge | Common research tools and techniques together with the fundamental knowledge relevant to multi-scale and multi-phase challenges present in water and environmental research will be discussed in this module. Both theory and application will be considered. | | | |
| Skills | In addition to the fundamental knowledge, the students will be exposed to several analytical, experimental and numerical too and techniques relevant to water and environmental research at different scales. This will provide the students with an exceller opportunity to improve their skills on multiple fronts which will be useful in their future career. | | | |
| Personal Competence | | | | |
| Social Competence | Developing teamwork and problem solving skills through Rese | arch-Based Teaching approaches | will be at the c | ore of this module |
| Autonomy | The students will be involved in writing individual reports and presentation. This will contribute to the students' ability ar willingness to work independently and responsibly. | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 | | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Subject theoretical and practical work | | | |
| Examination duration and | Report and Presentation | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Engineering: Elective | Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Water and Traffic: Elective Co | mpulsory | | |
| | Environmental Engineering: Specialisation Environment and Cl | imate: Elective Compulsory | | |
| | Water and Environmental Engineering: Specialisation Cities: El | ective Compulsory | | |
| | Water and Environmental Engineering: Specialisation Water: E | lective Compulsory | | |
| | Water and Environmental Engineering: Specialisation Environn | nent: Compulsory | | |

| Course L2754: Water and En | Course L2754: Water and Environment | | |
|----------------------------|---|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 3 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | |
| Lecturer | Dr. Salome Shokri-Kuehni | | |
| Language | EN | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Course L2753: Water and En | vironment |
|----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Prof. Nima Shokri |
| Language | EN |
| Cycle | SoSe |
| Content | Research based learning: The students will be engaged in active research focused on water and environmental related challenges. |
| | The required knowledge and tools will be discussed during the semester. |
| Literature | NA |

| C | | | | |
|--|--|--|--------------------|-------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Smart Monitoring (L2762) Smart Monitoring (L2763) | | Integrated Lecture Recitation Section (small) | 2 2 | 2 4 |
| | Dest Ver Creater | Recitation Section (smail) | Z | + |
| Module Responsible | | | | |
| Admission Requirements | | | | |
| | Basic knowledge or interest in object-oriented mod | | | |
| Knowledge | | | | |
| | skills of scientific working, are required. Basic knowledge in scientific writing and good English skills. | | | |
| Educational Objectives | After taking part successfully, students have reache | d the following learning results | | |
| Professional Competence | | | | |
| Knowledge | The students will become familiar with the princip | oles and practices of smart monitoring. T | The students wil | l be able to de |
| | decentralized smart systems to be applied for c | ontinuous (remote) monitoring of syster | ns in the built | and in the nat |
| | environment. In addition, the students will learn to a | | | |
| | analysis techniques, modern software design concer | | | |
| | also part of this module, which will be conducted th | nroughout the semester and will contribut | e to the grade. | In small groups, |
| | students will design smart monitoring systems that i | ntegrate a number of "intelligent" sensors | to be implemen | ted by the stude |
| | Specific focus will be put on the application of mad | chine learning techniques. The smart mor | itoring systems | will be mounted |
| | real-world (built or natural) systems, such as bridges | s or slopes, or on scaled lab structures for | validation purpo | ses. The outcom |
| | every group will be documented in a paper. All stude | ents of this module will "automatically" pa | rticipate with the | eir smart monito |
| | system in the annual "Smart Monitoring" competitio | n. The written papers and oral examination | ns form the final | grades. The mo |
| | will be taught in English. Limited enrollment. | | | |
| | | | | |
| Skills | The students will gain insights into operating state- | | | |
| | processes relevant to engineering, such as enviro | | | |
| | devising monitoring strategies of physical processe | | - | - |
| | implement the strategies in smart wireless sensor n | | ogramming. Final | ly, the students |
| | be able to document the findings of their projects in | short reports. | | |
| Personal Competence | | | | |
| | The students will be able to work in groups, share p | parts of the work for their projects, and de | velop communic | ation skills. tow |
| , | achieving the common project goals. | | | |
| | | | | |
| Autonomy | The students will be able to gain a solid basis on a | approaching and solving problems in engi | neering, as well | as on documer |
| | results, through their involvement in their monitoring | g group projects. | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture | 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | 10 pages of work with 15-minute oral presentation | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Water and Traffic: E | lective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engine | eering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Coastal Engineering | : Elective Compulsory | | |
| | Civil Engineering: Specialisation Structural Engineeri | ng: Elective Compulsory | | |
| | Computer Science: Specialisation II: Intelligence Eng | ineering: Elective Compulsory | | |
| | Environmental Engineering: Specialisation Energy ar | nd Resources: Elective Compulsory | | |
| | Environmental Engineering: Specialisation Environm | | | |
| | Environmental Engineering: Specialisation Water Qu | | pulsory | |
| | Mechatronics: Technical Complementary Course: Ele | | - | |
| | Mechatronics: Core Qualification: Elective Compulso | | | |
| | Theoretical Mechanical Engineering: Specialisation R | | ompulsory | |
| | Water and Environmental Engineering: Specialisation | | | |
| | Water and Environmental Engineering: Specialisation | | | |
| | | | | |

| Course L2762: Smart Monito | ring |
|----------------------------|--|
| Тур | Integrated Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Kay Smarsly |
| Language | EN |
| Cycle | SoSe |
| Content | In this course, principles of smart monitoring will be taught, focusing on modern concepts of data acquisition, data storage, and data analysis. Also, fundamentals of intelligent sensors and embedded computing will be illuminated. Autonomous software and decentralized data processing are further crucial parts of the course, including concepts of the Internet of Things, Industry 4.0 and cyber-physical systems. Furthermore, measuring principles, data acquisition systems, data management and data analysis algorithms will be discussed. Besides the theoretical background, numerous practical examples will be shown to demonstrate how smart monitoring may advantageously be used for assessing the condition of systems in the built or natural environment. |
| Literature | The course contents couples different fields, such as signal processing, sensing technologies, data analytics, environmental engineering, civil engineering, artificial intelligence, database systems, and many more. The basics will be taught in this course. However, specific literature that covers all these topics does not exist. Instead, literature will be referenced in the lectures, all of which are papers that are freely available online. |

| ourse L2763: Smart Monito | ring |
|---------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 4 |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 |
| Lecturer | Prof. Kay Smarsly |
| Language | EN |
| Cycle | SoSe |
| | The contents of the exercises are based on the lecture contents. In addition to the exercises, project work will be conducted throughout the semester, which will consume the majority of the workload. As part of the project work, students will design smart monitoring systems that will be tested in the laboratory or in the field. As mentioned in the module description, the students will participate in the "Smart Monitoring" competition, hosted annually by the Institute of Digital and Autonomous Construction. Students are encouraged to contribute their own ideas. The tools required to implement the smart monitoring systems will be taught in the group exercises as well as through external sources, such as video tutorials and literature. The course contents couples different fields, such as signal processing, sensing technologies, data analytics, environmental engineering, civil engineering, artificial intelligence, database systems, and many more. The basics will be taught in this course. However, specific literature that covers all these topics does not exist. Instead, literature will be referenced in the lectures, all of which are papers that are freely available online. |

| Courses | | | | | | |
|------------------------------------|--|------------------------|---------------------------|------------------------------------|-----------------|-------------------|
| Title | | | | Тур | Hrs/wk | СР |
| Waste management (L3261) | | | | Project-/problem-based Learning | 3 | 3 |
| International waste concepts (L32) | 59) | | | Lecture | 2 | 2 |
| International waste concepts (L326 | 50) | | | Recitation Section (small) | 1 | 1 |
| Module Responsible | Prof. Kerstin Kuchta | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Basics in process eng | ineering | | | | |
| Knowledge | | | | | | |
| Educational Objectives | After taking part succ | essfully, students ha | we reached the followi | ng learning results | | |
| Professional Competence | | | | | | |
| Knowledge | The students are abl | e to describe waste | as a resource as well | as advanced technologies for re | cycling and re | ecovery of resour |
| | from waste in detail. | This covers collection | n, transport, treatment | and disposal in national and inte | ernational con | texts. |
| <i></i> | | | e | | | |
| Skills | | | | with respect to the national or cu | | |
| | They can evaluate the | e ecological impact a | and the technical effort | of different technologies and ma | anagement sy | stems. |
| Personal Competence | | | | | | |
| Social Competence | Students can work together as a team of 2-5 persons, participate in subject-specific and interdisciplinary discussions, deve | | | | | |
| | cooperated solutions | and defend their ov | vn work results in from | t of others and promote the scie | entific develop | oment of colleagu |
| | Furthermore, they ca | n give and accept pr | ofessional constructive | e criticisms. | | |
| | | | | | | |
| Autonomy | | ndently gain additio | nal knowledge of the | subject area and apply it in so | olving the give | en course tasks |
| | projects. | | | | | |
| Workload in Hours | Independent Study Ti | ime 96, Study Time i | n Lecture 84 | | | |
| Credit points | 6 | | | | | |
| Course achievement | Compulsory Bonus | Form | Description | | | |
| | Yes 20 % | Written elaboration | า | | | |
| Examination | Presentation | | | | | |
| Examination duration and | PowerPoint presentat | ion (10-15 minutes) | | | | |
| scale | | | | | | |
| Assignment for the | Civil Engineering: Spe | ecialisation Water an | d Traffic: Elective Com | pulsory | | |
| Following Curricula | Chemical and Bioproc | cess Engineering: Sp | ecialisation General Pro | ocess Engineering: Elective Comp | oulsory | |
| | Chemical and Bioproc | cess Engineering: Sp | ecialisation Bioprocess | Engineering: Elective Compulsor | ry | |
| | Chemical and Bioproc | cess Engineering: Sp | ecialisation Chemical P | rocess Engineering: Elective Con | npulsory | |
| | Chemical and Bioproc | cess Engineering: Sp | ecialisation Chemical a | nd Bio process Engineering: Elec | tive Compulso | ory |
| | Chemical and Bioproc | cess Engineering: Co | re Qualification: Electiv | e Compulsory | | |
| | Environmental Engine | eering: Specialisatior | Energy and Resources | s: Elective Compulsory | | |
| | International Manage | ment and Engineerir | g: Specialisation II. Re | newable Energy: Elective Compu | llsory | |
| | Process Engineering: | Specialisation Enviro | onmental Process Engir | neering: Elective Compulsory | | |
| | Water and Environme | ental Engineering: Sp | ecialisation Cities: Elec | ctive Compulsory | | |
| | Materia and Environment | ental Engineering: Sp | | | | |

| Course L3261: Waste manag | ement |
|---------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 3 |
| CP | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Prof. Rüdiger Siechau |
| Language | EN |
| Cycle | SoSe |
| Content | Introduction into the "Waste Management" consisting of: Thermal Process (incinerator, RDF combustion) Biological processes (Wet-/Dryfermentation) technology, energy, emissions, approval, etc. Group work design of systems/plants for energy recovery from waste The following points are to be processed: Input: waste (fraction collection and transportation, current quantity, material flows, possible amount of development) Plant (design, process diagram, technology, energy production) Output (energy quantity / type, by-products) Costs and revenues Climate and resource protection (CO2 balance, substitution of primary raw materials / fossil fuels) Location and approval (infrastructure, expiration authorization procedure) Focus at the whole concept (advantages, disadvantages, risks and opportunities, discussion) |
| Literature | Einführung in die Abfallwirtschaft; Martin Kranert, Klaus Cord-Landwehr (Hrsg.); Vieweg + Teubner Verlag; 2010 Powerpoint-Folien in Stud IP |

| Course L3259: International | waste concepts |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Kerstin Kuchta |
| Language | EN |
| Cycle | SoSe |
| Content | Waste avoidance and recycling are the focus of this lecture. Additionally, waste logistics (Collection, transport, export, fees and taxes) as well as international waste shipment solutions are presented. Other specific wastes, e.g. industrial waste, treatment concepts will be presented and developed by students themselves Waste composition and production on international level, wast eulogistic, collection and treatment in emerging and developing countries. Single national projects and studies will be prepared and presented by students |
| Literature | Basel convention |

| Course L3260: International | ourse L3260: International waste concepts | | |
|-----------------------------|---|--|--|
| Тур | Recitation Section (small) | | |
| Hrs/wk | 1 | | |
| CP | 1 | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | |
| Lecturer | Prof. Kerstin Kuchta | | |
| Language | EN | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | | |
|--|---|--|------------------------|--------------------|--|
| Title | | Тур | Hrs/wk | СР | |
| Applied Surface Hydrology (L0289) | | Lecture | 2 | 2 | |
| Applied Surface Hydrology (L1412) | | Project-/problem-based L | - | 2 | |
| nteraction Water - Environment in | 1 | Project-/problem-based L | earning 1 | 2 | |
| Module Responsible | | | | | |
| Admission Requirements | | | | | |
| | Fundamentals of Hydromechanics and H | lydraulic Engineering: Hydraulic Engineering I an | d Hydraulic Engineer | ing II | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students | have reached the following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | The students are able to define the bas | sic concepts of hydrology and water management | nt. They are able to | describe and qua | |
| | the relevant processes of the hydrologic | cal water cycle. Besides, the students know the r | nain aspects of rainfa | all-run-off-models | |
| | are able to theoretically derive establish | ed reservoir / storage models and a unit-hydrogr | aph. | | |
| Skills | The students are able to use the basic hydrological concepts and approaches and are able to theoretically derive established | | | | |
| 56115 | reservoir / storage models or a unit-hydrograph as the basis for rainfall-run-off-models. The student are able to explain the basis | | | | |
| | | ical and hydrodynamic values in nature and are | | | |
| | | re, they are able to apply a hydrological model to | | - | |
| | ussess these measurements. Furtherme | re, they are able to apply a hydrological model a | busic injurbiografi p | i obierno. | |
| Personal Competence | | | | | |
| Social Competence | The students are able to deploy their ga | ined knowledge in applied problems of the hydro | logy and water man | agement. Additior | |
| | they will be able to work in team with e | ngineers of other disciplines. | | | |
| Autonomy | The students will be able to independen | tly extend their knowledge and apply it to new p | roblems | | |
| Workload in Hours | Independent Study Time 124, Study Tin | a in Lecture 56 | | | |
| Credit points | | | | | |
| Course achievement | | | | | |
| | | | | | |
| Examination | Written exam | | | | |
| Examination | | in. The examination includes tasks with respect t | the general unders | tanding of the lec | |
| Examination Examination duration and | | in. The examination includes tasks with respect t | to the general unders | tanding of the lec | |
| Examination Examination duration and scale | The duration of the examination is 90 m contents and calculations tasks. | in. The examination includes tasks with respect t | to the general unders | tanding of the lec | |
| Examination Examination duration and scale | The duration of the examination is 90 m contents and calculations tasks. Civil Engineering: Specialisation Compu | ational Engineering: Elective Compulsory | to the general unders | tanding of the lec | |
| Examination Examination duration and scale Assignment for the | The duration of the examination is 90 m contents and calculations tasks. Civil Engineering: Specialisation Compu | tational Engineering: Elective Compulsory and Traffic: Compulsory | to the general unders | tanding of the lec | |
| Examination Examination duration and scale Assignment for the | The duration of the examination is 90 m contents and calculations tasks. Civil Engineering: Specialisation Compu Civil Engineering: Specialisation Water a Environmental Engineering: Core Qualif | tational Engineering: Elective Compulsory and Traffic: Compulsory | | tanding of the lec | |
| Examination Examination duration and scale Assignment for the | The duration of the examination is 90 m contents and calculations tasks. Civil Engineering: Specialisation Compu Civil Engineering: Specialisation Water a Environmental Engineering: Core Qualif Joint European Master in Environmental | tational Engineering: Elective Compulsory and Traffic: Compulsory cation: Elective Compulsory | | tanding of the lec | |
| Examination Examination duration and scale Assignment for the | The duration of the examination is 90 m contents and calculations tasks. Civil Engineering: Specialisation Compu Civil Engineering: Specialisation Water a Environmental Engineering: Core Qualif Joint European Master in Environmental Water and Environmental Engineering: | tational Engineering: Elective Compulsory and Traffic: Compulsory cation: Elective Compulsory Studies - Cities and Sustainability: Core Qualifica | | tanding of the lec | |

| Course L0289: Applied Surfa | ce Hydrology |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Peter Fröhle |
| Language | DE/EN |
| Cycle | SoSe |
| Content | Basics of hydrology: Hydrological cycle Data acquisition Data analyses and statistical assessment Statistics of extremes Regionalization methods for hydrological values Rainfall-run-off modelling on the basis of a unit hydrograph conceps Application of rainfall-run-off models on the basis of Kalypso-Hydrology which is an OpenSource Software Tool. |
| Literature | http://de.wikipedia.org/wiki/Kalypso_(Software) http://kalypso.bjoernsen.de/ http://sourceforge.net/projects/kalypso/ |

| Course L1412: Applied Surfa | rse L1412: Applied Surface Hydrology | | |
|-----------------------------|---|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 1 | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 | | |
| Lecturer | Prof. Peter Fröhle | | |
| Language | DE/EN | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Course L0295: Interaction W | ater - Environment in Fluvial Areas |
|-----------------------------|--|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Peter Fröhle |
| Language | DE/EN |
| Cycle | SoSe |
| Content | A problem based learning course. The problem will be solved by the students more or less self-contained. The topics will be introduced and elaborated over the semester. |
| Literature | - |

| Courses | | | | | |
|-----------------------------------|---|-----------------------------------|--------------------------|--------------------|--------------------|
| Title | | Тур | | Hrs/wk | СР |
| Modeling Processes in Vadose Zone | e (L2735) | Recita | tion Section (small) | 2 | 2 |
| Vadose Zone Hydrology (L2732) | | Lectur | e | 2 | 2 |
| Vadose Zone Hydrology (L2733) | | Recita | tion Section (large) | 2 | 2 |
| Module Responsible | Prof. Nima Shokri | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Basic knowledge in water and soil | | | | |
| Knowledge | | | | | |
| | Comfortable with math and physics, crit | ical thinking, creative problem : | solving | | |
| | Analytic skills | | | | |
| | | | | | |
| Educational Objectives | After taking part successfully, students I | nave reached the following lear | ning results | | |
| Professional Competence | | | | | |
| Knowledge | The students will learn about soil cha | aracterization (solid and liquid | f phase), the energy | state of soil w | ater, the soil wa |
| | characteristic curve, flow in saturated an | nd unsaturated soil as well as a | bout solute transport in | n soil | |
| | | | | | |
| | | | | | |
| Skills | Students will work on practical exam | ples modelling transport proc | esses in soil using c | lifferent quantita | ative tools includ |
| | s Students will work on practical examples modelling transport processes in soil using different quantitative tools includir computer simulations and analytical tools. This will help them to apply knowledge in order to solve problems and tasks. | | | | |
| | | | | | |
| | | | | | |
| Demonal Competence | | | | | |
| Personal Competence | | | | | |
| Social Competence | The module aims at raising awareness | | wledge related to wa | ater, soil and en | ivironment. This |
| | positively contribute to shape their work | and life environment. | | | |
| | | | | | |
| | | | | | |
| Autonomy | The students will be involved in ma | ny problem solving exercises | 3. This will contribute | e toward their | willingness to w |
| | independently and responsibly. | | | | |
| | | | | | |
| Workload in Hours | Independent Study Time 96, Study Time | in Lecture 84 | | | |
| Credit points | 6 | | | | |
| Course achievement | None | | | | |
| Examination | Written elaboration | | | | |
| Examination duration and | Report and Presentation | | | | |
| scale | | | | | |
| Assignment for the | Civil Engineering: Specialisation Comput | ational Engineering: Elective Co | ompulsory | | |
| Following Curricula | Civil Engineering: Specialisation Water a | nd Traffic: Elective Compulsory | | | |
| | Environmental Engineering: Core Qualifi | cation: Elective Compulsory | | | |
| | | | | | |
| | Water and Environmental Engineering: 9 | Specialisation Water: Elective Co | ompulsory | | |

| Course L2735: Modeling Proc | cesses in Vadose Zone |
|-----------------------------|--|
| Тур | Recitation Section (small) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Mohammad Aziz Zarif |
| Language | EN |
| Cycle | SoSe |
| Content | Numerical tools will be introduced and used to quantify flow and transport processes in soil |
| Literature | NA |

| Course L2732: Vadose Zone | Hydrology |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Nima Shokri |
| Language | EN |
| Cycle | SoSe |
| Content | Soil solid phase characterization, Soil liquid phase characterization, The energy state of soil water, Soil Water Characteristic |
| | Curve, Flow in saturated soil, Flow in unsaturated soil, Solute transport in porous media |
| Literature | - Environmental Soil Physics, by Daniel Hillel |
| | - Soil Physics, Sixth Edition, by William A. Jury and Robert Horton |
| | - Physical Hydrology, Second Edition, by S. Lawrence Dingman |
| | - Introduction to Physical Hydrology, by Martin R. Hendriks |

| Course L2733: Vadose Zone | rse L2733: Vadose Zone Hydrology | | |
|---------------------------|---|--|--|
| Тур | Recitation Section (large) | | |
| Hrs/wk | 2 | | |
| CP | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Nima Shokri | | |
| Language | EN | | |
| Cycle | SoSe | | |
| Content | See interlocking course | | |
| Literature | See interlocking course | | |

| Courses | | | | | |
|---------------------------------|--|--------------------------------|----------------------------|---------------------|--|
| Title | | Тур | Hrs/wk | СР | |
| Rural Development and Resources | Oriented Sanitation for different Climate Zones (L0942) | Seminar | 2 | 3 | |
| Rural Development and Resources | Oriented Sanitation for different Climate Zones (L0941) | Lecture | 2 | 3 | |
| Module Responsible | Prof. Ralf Otterpohl | | | | |
| Admission Requirements | None | | | | |
| Recommended Previous | Basic knowledge of the global situation with rising povert | y, soil degradation, lack of v | vater resources and sanit | ation | |
| Knowledge | | | | | |
| Educational Objectives | After taking part successfully, students have reached the | following learning results | | | |
| Professional Competence | | | | | |
| Knowledge | Students can describe resources oriented wastewater s | stems mainly based on so | urce control in detail. Th | iey can comment o | |
| | techniques designed for reuse of water, nutrients and soi | conditioners. | | | |
| | Students are able to discuss a wide range of proven appr | aschos in Rural Dovelopmer | t from and for many road | one of the world | |
| | Students are able to discuss a wide range of proven appr | baches in Kurai Developiner | it noni and for many regi | ons of the world. | |
| | | | | | |
| Skills | Students are able to design low-tech/low-cost sanitation | n, rural water supply, rain | water harvesting system | is, measures for t | |
| | rehabilitation of top soil quality combined with food and | water security. Students can | consult on the basics of | soil building throu | |
| | "Holisitc Planned Grazing" as developed by Allan Savory. | | | | |
| Personal Competence | | | | | |
| | The students are able to develop a specific topic in a tea | n and to work out milestone | s according to a given pl | an | |
| Social Competence | The students are able to develop a specific topic in a teal | | s according to a given pr | | |
| Autonomy | Students are in a position to work on a subject and to | organize their work flow i | ndependently. They can | also present on th | |
| | subject. | | | | |
| 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 | During the course of the semester, the students work to | wards mile stones. The wor | k includes presentations | and papers. Detail | |
| scale | information will be provided at the beginning of the smes | ter. | | | |
| Assignment for the | Civil Engineering: Specialisation Water and Traffic: Electiv | e Compulsory | | | |
| Following Curricula | Bioprocess Engineering: Specialisation A - General Biopro | cess Engineering: Elective C | Compulsory | | |
| | Chemical and Bioprocess Engineering: Specialisation Ger | eral Process Engineering: El | ective Compulsory | | |
| | Environmental Engineering: Specialisation Environment a | nd Climate: Elective Compu | lsory | | |
| | Environmental Engineering: Specialisation Water Quality | and Water Engineering: Elec | tive Compulsory | | |
| | International Management and Engineering: Specialisation | n II. Energy and Environmer | tal Engineering: Elective | Compulsory | |
| | Process Engineering: Specialisation Environmental Proces | s Engineering: Elective Com | pulsory | | |
| | Process Engineering: Specialisation Process Engineering: | Elective Compulsory | | | |
| | Water and Environmental Engineering: Specialisation Wa | er: Elective Compulsory | | | |
| | Water and Environmental Engineering: Specialisation Env | ironment: Elective Compuls | ory | | |
| | | | | | |

| Course L0942: Rural Develop | ment and Resources Oriented Sanitation for different Climate Zones |
|-----------------------------|---|
| Тур | Seminar |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Ralf Otterpohl |
| Language | EN |
| Cycle | WiSe |
| Content | |
| | Central part of this module is a group work on a subtopic of the lectures. The focus of these projects will be based on an interview with a target audience, practitioners or scientists. The group work is divided into several Milestones and Assignments. The outcome will be presented in a final presentation at the end of the semester. |
| Literature | J. Lange, R. Otterpohl 2000: Abwasser - Handbuch zu einer zukunftsfähigen Abwasserwirtschaft. Mallbeton Verlag (TUHH Bibliothek) Winblad, Uno and Simpson-Hébert, Mayling 2004: Ecological Sanitation, EcoSanRes, Sweden (free download) Schober, Sabine: WTO/TUHH Award winning Terra Preta Toilet Design: http://youtu.be/w_R09cYq6ys |

| Course L0941: Rural Develop | ment and Resources Oriented Sanitation for different Climate Zones |
|-----------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Ralf Otterpohl |
| Language | EN |
| Cycle | WiSe |
| Content | Living Soil - THE key element of Rural Development Participatory Approaches Rainwater Harvesting Ecological Sanitation Principles and practical examples Permaculture Principles of Rural Development Performance and Resilience of Organic Small Farms Going Further: The TUHH Toolbox for Rural Development EMAS Technologies, Low cost drinking water supply |
| Literature | Miracle Water Village, India, Integrated Rainwater Harvesting, Water Efficiency, Reforestation and Sanitation: http://youtu.be/9hmkgn0nBgk Montgomery, David R. 2007: Dirt: The Erosion of Civilizations, University of California Press |

| Courses | | | | |
|-----------------------------------|--|---|----------------|---------------------|
| Title | | Тур | Hrs/wk | СР |
| Process Modelling of Wastewater T | | Project-/problem-based Learning | 2 | 3 |
| Process Modeling in Drinking Wate | r Treatment (L0314) | Project-/problem-based Learning | 2 | 3 |
| Module Responsible | Dr. Klaus Johannsen | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Knowledge of the most important processes in d | rinking water and waste water treatment. | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have rea | ched the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Students are able to explain selected processes | s of drinking water and waste water treatment i | n detail. They | y are able to expla |
| | basics as well as possibilities and limitations of o | lynamic modeling. | | |
| Skills | Students are able to use the most important fe | atures Modelica offers. They are able to transpo | se selected r | processes in drinki |
| JKIIIS | | natical model in Modelica with respect to equilib | | |
| | They are able to set up and apply models and as | | num, kneues | |
| | They are able to set up and apply models and a | | | |
| | | | | |
| Personal Competence | | | | |
| • | Students are able to solve problems and docum | ant colutions in a group with mombars of differe | nt tochnical b | ackground Thou a |
| Social Competence | | constructively with feedback concerning their wo | | ackyrounu. mey a |
| | able to give appropriate reeuback and can work | constructively with reeaback concerning their we | лк. | |
| | | | | |
| Autonomu | Students are able to define a problem, gain the | required knowledge and get up a model | | |
| Αυτοποπγ | Students are able to define a problem, gain the r | required knowledge and set up a model. | | |
| | | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lec | ture 56 | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | Oral exam | | | |
| Examination duration and | 30 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Water and Traff | ic: Elective Compulsory | | |
| Following Curricula | | | | |
| | Environmental Engineering: Specialisation Water | Quality and Water Engineering: Elective Compu | lsory | |
| | Process Engineering: Specialisation Environment | al Process Engineering: Elective Compulsory | | |
| | Process Engineering: Specialisation Process Engi | neering: Elective Compulsory | | |
| | Water and Environmental Engineering: Specialis | ation Water: Elective Compulsory | | |
| | Water and Environmental Engineering: Specialis | ation Environment: Elective Compulsory | | |
| | Water and Environmental Engineering: Specialis | ation Cities: Elective Compulsory | | |

| Course L0522: Process Mode | lling of Wastewater Treatment |
|----------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Dr. Joachim Behrendt |
| Language | DE/EN |
| Cycle | WiSe |
| Content | Mass and energy balances |
| | Tracer modelling |
| | Activated Sludge Model |
| | Wastewater Treatment Plant Modelling (continously and SBR) |
| | Sludge Treatment (ADM, aerobic autothermal) |
| | Biofilm Modelling |
| Literature | Henze, Mogens (Seminar on Activated Sludge Modelling, ; Kollekolle Seminar on Activated Sludge Modelling, ;) |
| | Activated sludge modelling : processes in theory and practice ; selected proceedings of the 5th Kollekolle Seminar on Activated |
| | Sludge Modelling, held in Kollekolle, Denmark, 10 - 12 September 2001 |
| | ISBN: 1843394146 |
| | [London] : IWA Publ., 2002 |
| | TUB_HH_Katalog |
| | Henze, Mogens |
| | Activated sludge models ASM1, ASM2, ASM2d and ASM3 |
| | ISBN: 1900222248 |
| | London : IWA Publ., 2002 |
| | TUB_HH_Katalog |
| | Henze, Mogens |
| | Wastewater treatment : biological and chemical processes |
| | ISBN: 3540422285 (Pp.) |
| | Berlin [u.a.] : Springer, 2002 |
| | TUB_HH_Katalog |
| | Wiesmann, Udo (Choi, In Su; Dombrowski, Eva-Maria;) |
| | Fundamentals of biological wastewater treatment |
| | ISBN: 3527312196 (Gb.) URL: http://deposit.ddb.de/cgi-bin/dokserv?id=2774611&prov=M&dok_var=1&dok_ext=htm |
| | Weinheim : WILEY-VCH, 2007 |
| | TUB_HH_Katalog |
| | |

| Course L0314: Process Mode | ling in Drinking Water Treatment |
|----------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Dr. Klaus Johannsen |
| Language | EN |
| Cycle | WiSe |
| Content | In this course selected drinking water treatment processes (e.g. aeration or activated carbon adsorption) are modeled dynamically using the programming language Modelica, that is increasingly used in industry. In this course OpenModelica is used, an free access frontend of the programming language Modelica. In the beginning of the course the use of OpenModelica is explainded by means of simple examples. Together required elements and structure of the model are developed. The implementation in OpenModelica and the application of the model is done individually or in groups respectively. Students get feedback and can gain extra points for the exam. |
| Literature | OpenModelica: https://openmodelica.org/index.php/download/download-windows OpenModelica - Modelica Tutorial: https://openmodelica.org/index.php/useresresources/userdocumentation OpenModelica - Users Guide: https://openmodelica.org/index.php/useresresources/userdocumentation Peter Fritzson: Principles of Object-Oriented Modeling and Simulation with Modelica 2.1,Wiley-IEEE Press, ISBN 0-471-471631. MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John Wiley & Sons, Hoboken, 2005. Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley & Sons, New York, 1996. DVGW (Hrsg.): Wasseraufbereitung - Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004. |

| | rete Structures | ة | | | | |
|---|---|--|--|-----------------------|--------------------|--|
| Courses | | | | | | |
| Fitle | | | Тур | Hrs/wk | СР | |
| Concrete Structures (L0579) | | | Seminar | 1 | 1 | |
| Structural Concrete Members (L05) | 77) | | Lecture | 2 | 3 | |
| Structural Concrete Members (L05 | 78) | | Recitation Section (large) | 2 | 2 | |
| Module Responsible | NN | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Basics of structural a | Basics of structural analysis, conception and dimensioning of structural concrete | | | | |
| Knowledge | | | | | | |
| | Modules: Reinforced | Concrete Structures I+ | -II, Structural Analysis I+II, Mechanics I+II | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | After taking part suc | cessfully, students hav | e reached the following learning results | | | |
| Professional Competence | | | | | | |
| Knowledge | | | ral engineering, especially in the field of buildin | | | |
| | the knowledge for th | e conception and desig | on of concrete buildings and structural member | s that are often used | d. | |
| Skills | The students are ab | le to apply procedures | of the conception and dimensioning to to prac | tical problems of st | ructural engineeri | |
| 511115 | | | ings and to design them for general action | | | |
| | | | and construction sketches and draw up techni | | a chen accumig a | |
| | execution. Horeover | , they can make design | rand construction sketches and draw up teenin | icul descriptions. | | |
| Personal Competence | | | | | | |
| Social Competence | The students are abl | le to obtain results of h | igh quality in teamwork. | | | |
| Autonomy | The students are abl | le to carry out complex | conception and dimensioning tasks of structure | es under the quidan | co of tutors | |
| hatohomy | The statents are us | le to carry out complex | | es under the guidant | | |
| | Independent Study T | Fime 110, Study Time in | n Lecture 70 | | | |
| Workload in Hours | | | | | | |
| Workload in Hours Credit points | | | | | | |
| | Compulsory Bonus | Form | Description | | | |
| Credit points Course achievement | Compulsory Bonus No None | Form Presentation | Description Es werden 2 Referate ausgegeben | | | |
| Credit points Course achievement Examination | Compulsory Bonus No None Written exam | | • | | | |
| Credit points Course achievement | Compulsory Bonus No None Written exam | | • | | | |
| Credit points Course achievement Examination | Compulsory Bonus No None Written exam | | • | | | |
| Credit points Course achievement Examination Examination duration and scale | Compulsory Bonus No None Written exam 120 minutes | Presentation | • | | | |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Sp | Presentation | Es werden 2 Referate ausgegeben | | | |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Sp Civil Engineering: Sp | Presentation pecialisation Structural l pecialisation Geotechnic | Es werden 2 Referate ausgegeben | | | |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Sp Civil Engineering: Sp Civil Engineering: Sp Civil Engineering: Sp | Presentation pecialisation Structural pecialisation Geotechnic pecialisation Coastal En | Es werden 2 Referate ausgegeben | | | |
| Credit points Course achievement Examination Examination duration and scale Assignment for the | Compulsory Bonus No None Written exam 120 minutes Civil Engineering: Sp Civil Engineering: Sp Civil Engineering: Sp Civil Engineering: Sp | Presentation pecialisation Structural pecialisation Geotechnic pecialisation Coastal En- pecialisation Water and | Es werden 2 Referate ausgegeben Engineering: Compulsory cal Engineering: Elective Compulsory gineering: Elective Compulsory | | | |

| Course L0579: Concrete Structures | |
|-----------------------------------|---|
| Тур | Seminar |
| Hrs/wk | 1 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | NN |
| Language | DE |
| Cycle | WiSe |
| Content | With help of a project teamwork the subjects of the course "Concrete Structures" is practiced, discussed and presented. |
| Literature | - Projektbezogene Unterlagen werden abgegeben. |

| Hrsiwk 2 CP 3 Workload in Hours Independent Study Time 62, Study Time in Lecture 28 Lecturer NN Language DE Cycle WiSe Content • skyscrapers: structural elements • actions on structrues • bracing systems • design of slabs (line and point supported plates and floor slabs) • membranes and deep beams • folded plates and shells • truss models • reinforced and prestressed members Vorlesungsunterlagen können im STUDIP heruntergeladen werden · Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 200 • Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 • Deutscher Ausschuss für Stahlbeton: Hef 600: Erläuterungen zu DIN EN 1992-1-1. Beuth Verlag, Berlin 2012 • Deutscher Ausschuss für Stahlbeton: Hef 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen vorstahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 • Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalend 1992, Teil 1, 287-366, Verlag Ernst & Sohn, Berlin 1992 • Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin 1992 | Түр | Lecture |
|--|-------------------|--|
| CP 3 Workload in Hours Independent Study Time 62, Study Time in Lecture 28 Lecturer NN Language DE Cycte WiSe Content • skyscrapers: structural elements • actions on structrues • bracing systems • design orf slabs (line and point supported plates and floor slabs) • membranes and deep beams • folded plates and shells • truss models • reinforced and prestressed members Vorlesungsunterlagen können im STUDIP heruntergeladen werden • Zlich K., Zehetmaier G.: Bemessung Im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 200. • Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 • Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen vor Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 • Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalend 1992, Teil 1, 287-366, Verlag Ernst & Sohn, Berlin 1992 • Stiglat/Wippe!: Platten. Verlag Ernst & Sohn, Berlin 1992 Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin 1 | | |
| Lecturer NN Language DE Cycle WiSe Content • skyscrapers: structural elements • actions on structrues • bracing systems • design orf slabs (line and point supported plates and floor slabs) • membranes and deep beams • folded plates and shells • truss models • truss models • reinforced and prestressed members Literature Vorlesungsunterlagen können im STUDiP heruntergeladen werden • Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 200 • Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 • Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen v. Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 • Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalend 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992 • Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin 1992 | | |
| Language DE Cycle WiSe Content | Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Cycle WiSe Content • skyscrapers: structural elements • actions on structrues • bracing systems • design orf slabs (line and point supported plates and floor slabs) • membranes and deep beams • folded plates and shells • truss models • reinforced and prestressed members Literature Vorlesungsunterlagen können im STUDIP heruntergeladen werden • Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 200. • Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 • Deutscher Ausschuss für Stahlbeton: Heft 200: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 • Deutscher Ausschuss für Stahlbeton: Heft 200: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen vo Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 • Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalend 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992 • Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin, 1973 | Lecturer | NN |
| Content • skyscrapers: structural elements • actions on structrues • bracing systems • design orf slabs (line and point supported plates and floor slabs) • membranes and deep beams • folded plates and shells • truss models • reinforced and prestressed members Vorlesungsunterlagen können im STUDiP heruntergeladen werden • Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 200. • Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 • Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen vor Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 • Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalend 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992 • Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin 1973 | Language | DE |
| skyscrapers: structural elements actions on structrues bracing systems design orf slabs (line and point supported plates and floor slabs) membranes and deep beams folded plates and shells truss models reinforced and prestressed members Literature Vorlesungsunterlagen können im STUDiP heruntergeladen werden Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 200 Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen vor Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalend 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1973 | Cycle | WiSe |
| Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2000 Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen vor Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalend 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992 Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin, 1973 | Content | actions on structrues bracing systems design orf slabs (line and point supported plates and floor slabs) membranes and deep beams folded plates and shells truss models |
| Schlaich J.; Schlarer K.: Konstruieren im Stanibetonbau. Betonkalender 1998, Ieli II, S. 721R, Verlag Ernst & Sonn, Berlin 1998 | Literature | Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003 Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen vor Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalende 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992 Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin, 1973 Schlaich J.; Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst & Sohn, Berlin, 1973 |

| Course L0578: Structural Concrete Members | |
|---|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | NN |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Module M0963: Steel | and Composite Structures | | | |
|------------------------------------|---|---|------------|----|
| | | | | |
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Steel and Composite Structures (LI | .204) | Lecture | 2 | 2 |
| Steel and Composite Structures (LI | 205) | Recitation Section (large) | 2 | 2 |
| Steel Bridges (L1097) | | Lecture | 2 | 2 |
| Module Responsible | Prof. Marcus Rutner | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basics of steel construction (i.e. Steel Structures I and | I II, BUBC) | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached | the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After successful completition, students can | | | |
| | describe the phenomenon of local buckling | | | |
| | explain warping torsion | | | |
| | illustrate the behaviour of composite structures | - | | |
| | | | | |
| | specify the principles in design of composite still | | | |
| | sketch the contructions of steel and composite | bridges | | |
| Skills | After successful participation students are able to | | | |
| | check stiffened and unstiffened plated structure | es | | |
| | recognize and verify warping tosion in strucure | S | | |
| | design composite structures | | | |
| | design bridges and o perform the detailing | | | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 | 1 | | |
| Credit points | | | | |
| Course achievement | None | | | |
| Examination | Written exam | | | |
| Examination duration and | 180 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineerin | g: Compulsory | | |
| Following Curricula | | | | |
| | Civil Engineering: Specialisation Coastal Engineering: | | | |
| | Civil Engineering: Specialisation Water and Traffic: Ele | | | |
| | Civil Engineering: Specialisation Computational Engine | | | |
| | International Management and Engineering: Specialise | | oulsory | |
| | incentational management and Engineering. Specialis | action in crim Engineering. Liective Comp | , ai 301 y | |

| Course L1204: Steel and Con | Course L1204: Steel and Composite Structures | | |
|-----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 2 | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | |
| Lecturer | Prof. Marcus Rutner | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Local-buckling of plated structures Warping torsion Composite-girders, -columns, -slabs, -bridges Principles in composite constructions Bridge-design and -construction | | |
| Literature | Petersen, C.: Stahlbau, 4.Auflage 2013, Springer-Vieweg Verlag Minnert, J. Wagenknecht, G.: Verbundbau-Praxis - Berechnung und Konstruktion nach Eurocode 4, 2.Auflage 2013, Bauwerk Beuth Verlag | | |

| Course L1205: Steel and Con | ourse L1205: Steel and Composite Structures | |
|-----------------------------|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Marcus Rutner | |
| Language | DE | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Course L1097: Steel Bridges | |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Yves Freundt |
| Language | |
| Cycle | |
| Content | Lecture Contents ,Steel Bridge Construction |
| | DrIng. Jörg Ahlgrimm |
| | - From tendering and contracting to completion - the development of a steel bridge |
| | - Contents of a bridge static - structural details, examples of analysis in detail: |
| | -> effective width in regard to the longitudinal stiffeners |
| | -> Bearing point, bearing stiffener |
| | -> Crossbeam breakthrough, crossbeam reinforcement |
| | -> Analysis of the Rib-to-Floorbeam (RF) connection (web-tooth of the floorbeam between trapezoidal shaped Ribs) |
| | - Steel grades, -designation, testing methods and approval certificates |
| | - Nondestructive weld inspecting |
| | - Corrosion protection |
| | - Bridge bearing - types, format, function, dimensioning, installation |
| | - Expansion Joints |
| | - Oscillation of bridge hangers and cables - oscillation damper |
| | - Opening bridges- Detailed reviews to different assembling procedures and - implements |
| | - Selective damage events |
| | Requirements: Basic knowledge in the calculation, dimensioning, and construction of structural elements and joints of constructional steelwork |
| Literature | |
| | Herbert Schmidt, Ulrich Schulte, Rainer Zwätz, Lothar Bär: Ausführung von Stahlbauten |
| | Petersen, Christian: Stahlbau, Abschnitt Brückenbau |
| | Ahlgrimm, J., Lohrer, I.: Erneuerung der Eisenbahnüberführung in Fulda-Horas über die Fulda, Stahlbau 74 (2005), Heft 2, S. 114 |

| Courses | | | | |
|---------------------------------|---|--|----------------------|---------------------|
| Title | | Тур | Hrs/wk | СР |
| Water Protection and Wastewater | - | Lecture | 3 | 3 |
| Water Protection and Wastewater | | Project Seminar | 3 | 3 |
| Module Responsible | Prof. Ralf Otterpohl | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge in water management; | | | |
| Knowledge | Good knowledge in urban drainage; | | | |
| | Good knowledge of wastewater treatment | t techniques; | | |
| | Good knowledge of pollutants (e.g. COD, | BOD, TS, N, P) and their properties; | | |
| Educational Objectives | After taking part successfully, students have rea | ached the following learning results | | |
| Professional Competence | Arter taking part successfully, students have rea | actied the following learning results | | |
| | The students can describe the basic principles o | of the regulatory framework related to the | international and Fu | Ironean water sect |
| Khowicage | They can explain limnological processes, subs | | | |
| | problems related to water protection, such as | | | |
| | solutions, remediation measures as well as cond | | | |
| | | | | |
| Skills | Students can accurately assess current probler | | - | |
| | actions to contribute to the planning of tomo | | they can suggest a | ppropriate technica |
| | administrative and legislative solutions to solve | these problems. | | |
| | | | | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | The students can work together in international | groups. | | |
| | | | | |
| | | | | |
| | | | | |
| Autonomv | Students are able to organize their work flow to | o prepare presentations and discussions. | They can acquire ap | propriate knowledg |
| | by making enquiries independently. | | ., | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Lect | ure 84 | | |
| Credit points | | | | |
| Course achievement | | | | |
| Examination | | | | |
| | Term paper plus presentation | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engin | neering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering | ngineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Coastal Engine | ering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Water and Traf | fic: Elective Compulsory | | |
| | Environmental Engineering: Specialisation Wate | r Quality and Water Engineering: Elective | Compulsory | |
| | International Management and Engineering: Spe | ecialisation II. Civil Engineering: Elective C | Compulsory | |
| | Water and Environmental Engineering: Specialis | | | |
| | Water and Environmental Engineering: Specialis | | | |
| | Water and Environmental Engineering: Specialis | sation Environment: Compulsory | | |

| Course L0226: Water Protect | tion and Wastewater Management |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Prof. Ralf Otterpohl |
| Language | EN |
| Cycle | WiSe |
| Content | The lecture focusses on: Regulatory Framework (e.g. WFD) Main instruments for the water management and protection In depth knowledge of relevant measures of water pollution control Urban drainage, treatment options in different regions on the world Rainwater management, improved management of heavy rainfalls, downpours, rainwater harvesting, rainwater infiltration Case Studies and Field Trips |
| Literature | The literature listed below is available in the library of the TUHH. Water and wastewater technology Hammer, M. J. 1., & . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International. Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011) New York, NY: McGraw-Hill. Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ. |

| Course L2008: Water Protection and Wastewater Management | |
|--|---|
| Тур | Project Seminar |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Prof. Ralf Otterpohl |
| Language | EN |
| Cycle | WiSe |
| Content | |
| Literature | |

| Courses | | | | |
|---|---|---|--------------------|----------------------|
| Title | | Тур | Hrs/wk | СР |
| Numerical Methods in Geotechnics | (L0375) | Lecture | 3 | 3 |
| Advanced Foundation Engineering | | Lecture | 2 | 2 |
| Advanced Foundation Engineering | (L0498) | Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof. Jürgen Grabe | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Geotechnics I and II, Mathematics I-III | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reach | ned the following learning results | | |
| Professional Competence | | | | |
| Knowledge | After successfully completing the module, student | s will be able to | | |
| | | | | |
| | describe individual procedures for the geote | | asures, | |
| | reproduce exploration and investigation me | | | |
| | select suitable types of field and laboratory | | | |
| | state the differences between various stres | s and deformation states and the physical : | significance of in | variants of the stre |
| | and distortion tensor, | | | |
| | outline the standard and special soil mecha | | in behavior of so | 11, |
| | describe continuum models and the resultir | | | |
| | as well as define boundary value problems | from the field of geotechnical engineering | in such a way tha | it they can be solv |
| | unambiguously. | | | |
| Skills | Students will be able to | | | |
| | | | | |
| | dimension vertical drains for soil improvement | | | |
| | calculate depth compaction using various a | | | |
| | apply principles of horizontal bearing capac | | | |
| | verify the internal and external stability of f | | | |
| | evaluate the boundary conditions for the | e design of a deep excavation and desig | n the individual | components of t |
| | excavation, | | | |
| | perform, evaluate and interpret tests for the | | rding to applicab | le standards, |
| | computationally implement numerical algor | | | |
| | select and apply the types of analyses dependence | • • • | | |
| | determine appropriate model parameters for | or different possibilities and limitations of m | naterial models fo | or the grain structu |
| | of soils. | | | |
| Personal Competence | | | | |
| • | Students can work in groups and support each oth | ner in finding solutions | | |
| | | | | |
| Autonomy | Students are able to assess their own strengths ar | nd weaknesses and, based on this, organize | their time and le | earning manageme |
| | and think in terms of processes. | | | |
| Workload in Hours | Independent Study Time 96, Study Time in Locture | e 84 | | |
| Credit points | Independent Study Time 96, Study Time in Lecture 84 | | | |
| Course achievement | | | | |
| Examination | Written exam | | | |
| Examination duration and | 120 min | | | |
| scale | | | | |
| scale | Civil Engineering: Specialisation Structural Engineer | ering: Compulsory | | |
| Accianment for the | | | | |
| Assignment for the | Civil Engineering, Engeralization Costochnics, France | | | |
| Assignment for the Following Curricula | Civil Engineering: Specialisation Geotechnical Engineering | | | |
| | Civil Engineering: Specialisation Coastal Engineeri | ng: Compulsory | | |
| | | ng: Compulsory : Elective Compulsory | | |

| Course L0375: Numerical Me | Course L0375: Numerical Methods in Geotechnics | | |
|----------------------------|---|--|--|
| Тур | Lecture | | |
| Hrs/wk | 3 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | |
| Lecturer | Dr. Hans Mathäus Stanford | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Topics: | | |
| | Introduction to numerical soil mechanics Introduction to numerical mathematics Finite Element Method (analysis procedures, algorithms) Finite Element Method (application in geotechnical engineering) | | |
| Literature | Wriggers P. (2001): Nichtlineare Finite-Elemente-Methoden. Springer Wriggers P. (2008): Nonlinear Finite Element Methods. Springer Deutsche Gesellschaft für Geotechnik e.V. (Hrsg., 2014): Empfehlungen des Arbeitskreises "Numerik in der Geotechnik". Ernst & Sohn | | |

| Course L0497: Advanced Foundation Engineering | | | | | |
|---|---|--|--|--|--|
| Тур | Lecture | | | | |
| Hrs/wk | 2 | | | | |
| СР | 2 | | | | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | | | | |
| Lecturer | Prof. Jürgen Grabe | | | | |
| Language | DE | | | | |
| Cycle | WiSe | | | | |
| Content | Vertical drains Piles Ground improvement (Deep Compaction, Soil mixing) Vibration driving Jet grouting Slurry wall Deep excavation | | | | |
| Literature | EAK (2002): Empfehlungen für Küstenschutzbauwerke EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke EAB (1988): Empfehlungen des Arbeitskreises Baugruben Grundbau-Taschenbuch, Teil 1-3, (1997), Ernst & Sohn Verlag | | | | |

| Course L0498: Advanced Foundation Engineering | | | | | |
|---|---|--|--|--|--|
| Тур | Recitation Section (large) | | | | |
| Hrs/wk | 1 | | | | |
| CP | 1 | | | | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | | | | |
| Lecturer | Prof. Jürgen Grabe | | | | |
| Language | DE | | | | |
| Cycle | WiSe | | | | |
| Content | See interlocking course | | | | |
| Literature | See interlocking course | | | | |

| Module M1720: Emer | ging Trends in Environmen | ital Engineering | | | | |
|---------------------------------------|---|---|-------------------------|--------------------|--|--|
| Courses | | | | | | |
| Title | | Тур | Hrs/wk | СР | | |
| Environmental Research Trends (L2752) | | Seminar | 2 | 2 | | |
| Microplastics in Environment (L2750) | | Lecture | 2 | 2 | | |
| Scientific Communication and Meth | ods (L2751) | Lecture | 1 | 2 | | |
| Module Responsible | Prof. Nima Shokri | | | | | |
| Admission Requirements | None | | | | | |
| Recommended Previous | Basic knowledge on water, soil and env | vironmental research. | | | | |
| Knowledge | | | | | | |
| Educational Objectives | After taking part successfully, students | s have reached the following learning results | | | | |
| Professional Competence | | | | | | |
| Knowledge | The students will be exposed to up-to-date research topics focused on soil, water and climate related challenges with a particula | | | | | |
| | focus on the effects of microplastics in environment. Data analysis, data measurement, curation and presentation will be other | | | | | |
| | skills that the students will develop in this module. | | | | | |
| | | | | | | |
| | | | | | | |
| Skills | 5 Students' research skills will be improved in this module. How to prepare and deliver an effective presentation, how to write | | | | | |
| | abstract, research paper and proposal will be discussed in this module. Moreover, through Research-Based Learning approache | | | | | |
| | the students will be exposed to current research trends in environmental engineering. | | | | | |
| | | | | | | |
| Demonal Commentered | | | | | | |
| Personal Competence | Developing teamwork and problem col | wing skills through Research Resead Teaching and | proaches will be at the | coro of this modul | | |
| Social Competence | Developing teamwork and problem sol | eveloping teamwork and problem solving skills through Research-Based Teaching approaches will be at the | | | | |
| Autonomy | The students will be involved in writing individual reports and presentation. This will contribute to the students' ability ar | | | | | |
| | willingness to work independently and responsibly. | | | | | |
| Workload in Hours | Independent Study Time 110, Study Ti | ime in Lecture 70 | | | | |
| Credit points | | | | | | |
| Course achievement | | | | | | |
| | Subject theoretical and practical work | | | | | |
| Examination duration and | | | | | | |
| scale | | | | | | |
| Assignment for the | Civil Engineering: Specialisation Water | and Traffic: Elective Compulsory | | | | |
| - | Environmental Engineering: Specialisation Environment and Climate: Elective Compulsory | | | | | |
| | Water and Environmental Engineering: Specialisation Cities: Elective Compulsory | | | | | |
| | Water and Environmental Engineering: Specialisation Environment: Elective Compulsory | | | | | |
| | | | | | | |

| Course L2752: Environmental Research Trends | |
|---|--|
| Тур | Seminar |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Dr. Salome Shokri-Kuehni |
| Language | EN |
| Cycle | WiSe |
| Content | Introduction - course objectives, expectations and format |
| | Analyzing the Audience, purpose and occasion |
| | Constructing and delivering effective technical presentations |
| | How to write an abstract |
| | How to write a scientific paper |
| | Developing competitive and persuasive research proposals |
| | Databases and resources available for water and environmental research |
| | Individual proposal on water and environmental research |
| | Individual project on water and environmental research |
| | Presentation on water and environmental research |
| Literature | The Craft of Scientific Writing Fourth edition Author: Michael Alley Springer-Verlag New York, Copyright 2018, DOI 10.1007/978-1-4419-8288-9 Supplemental materials and web links which will be available to registered students. |

| Course L2750: Microplastics | in Environment |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Nima Shokri |
| Language | EN |
| Cycle | WiSe |
| Content | - Introduction, objectives, expectations, format, importance |
| | - Sources of microplastics in environment |
| | - Microplastics sampling; Characterization of microplastics |
| | - Distribution of microplastics in terrestrial environments |
| | - Fate of microplastics in terrestrial environments |
| | - Project discussion |
| | - Effects of microplastics on terrestrial environments |
| | - Health risks of microplastics in environments |
| | - Project presentations by all students |
| Literature | - Microplastics in Terrestrial Environments (2021), Edited by Defu He and Yongming Luo |
| | - Particulate Plastics in Terrestrial and Aquatic Environments (2020), Edited by Nanthi S. Bolan et al. |
| | - Microplastic Pollutants (2017), by Christopher B. Crawford and Brian Quinn |

| Тур | Lecture |
|-------------------|--|
| Hrs/wk | 1 |
| СР | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Nima Shokri |
| Language | EN |
| Cycle | WiSe |
| Content | Introduction - course objectives, expectations and format |
| | Analyzing the Audience, purpose and occasion |
| | Constructing and delivering effective technical presentations |
| | How to write an abstract |
| | How to create a scientific poster |
| | How to write a scientific paper |
| | Developing competitive and persuasive research proposals |
| | Individual project (report and presentation) related to soil, water and environmental research |
| Literature | The Craft of Scientific Writing Fourth edition |
| | Author: Michael Alley Springer-Verlag New York, Copyright 2018, DOI 10.1007/978-1-4419-8288-9 |
| | Supplemental materials and web links which will be available to registered students. |

| Courses | |
|--------------------------------|--|
| Title | Typ Hrs/wk CP |
| Module Responsible | Dozenten des SD B |
| Admission Requirements | None |
| Recommended Previous | Subjects of the Water Management and Waste specialisation. |
| Knowledge | |
| Educational Objectives | After taking part successfully, students have reached the following learning results |
| Professional Competence | |
| Knowledge | The students are able to demonstrate their detailed knowledge in the field of water management and waste. They can exempl the state of technology and application and discuss critically in the context of actual problems and general conditions of scient and society. The students can develop solving strategies and approaches for fundamental and practical problems in the field of water management and waste. They may apply theory based procedures and integrate safety-related, ecological, ethical, and econom view points of science and society. |
| | Scientific work techniques that are used can be described and critically reviewed. |
| Skills | The students are able to independently select methods or planning approaches for the project work and to justify their choir They can explain how these methods or approaches relate to solutions in the field of work and how the context of application h to be adjusted. General findings and further developments may essentially be outlined. |
| Personal Competence | |
| Social Competence | The students are able to condense the relevance and the structure of the project work, the work steps and the sub-problems the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to th colleagues. |
| Autonomy | The students are capable of independently planning and documenting the work steps and procedures while considering the giv deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedba from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology |
| Workload in Hours | Independent Study Time 180, Study Time in Lecture 0 |
| Credit points | 6 |
| Course achievement | None |
| Examination | Study work |
| Examination duration and scale | See FSPO |
| | Civil Engineering: Specialisation Water and Traffic: Compulsory |
| Following Curricula | |

Module M0969: Selected Topics in Civil Engineering

| Courses | | | | |
|---|--|---|---------------------|----------------------|
| Title | | Тур | Hrs/wk | СР |
| Design of Composite Bridges (L3092) | | Integrated Lecture | 2 | 3 |
| Analysis of Offshore Structures (L1867) | | Lecture | 1 | 1 |
| Energy Geotechnics (L3227) | | Lecture | 3 | 3 |
| Solid Matter Process Technology for | r Biomass (L0052) | Lecture | 2 | 3 |
| Forum I - Geotechnics and Construction Management (L1634) | | Seminar | 1 | 1 |
| Forum II - Geotechnics and Constru | uction Management (L1635) | Seminar | 1 | 1 |
| Timber Structures (L1151) | | Seminar | 2 | 2 |
| Innovative Timber Construction (L2 | 2666) | Lecture | 2 | 4 |
| Glass Structures (L1152) | | Lecture | 2 | 2 |
| Glass Structures (L1447) | | Recitation Section (large) | 1 | 1 |
| Sustainable landfill design and ope | ration (L3270) | Integrated Lecture | 3 | 3 |
| Special Topics in Steel Design (L30 | 91) | Integrated Lecture | 2 | 3 |
| Special topics of civil engineering | LCP (L2378) | | 1 | 1 |
| Special topics of civil engineering 2 | 2 LP (L2379) | | 2 | 2 |
| Special topics of civil engineering 3 | 3 LP (L2380) | | 3 | 3 |
| Structural Design (L2789) | | Seminar | 2 | 2 |
| Module Responsible | Prof. Frank Schmidt-Döhl | | | |
| Admission Requirements | None | | | |
| Recommended Previous | none | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached | d the following learning results | | |
| Professional Competence | | | | |
| Knowledge | | | | |
| 5 | Students are able to find their way through se | lected special areas within civil and struc | tural engineering |]. |
| | Students are able to explain basic models and | d procedures in selected special areas of | civil and structura | al engineering. |
| | Students are able to interrelate scientific and | technical knowledge. | | |
| Skills | Students are able to apply basic methods in set | elected areas of civil and structural engir | neering. | |
| Personal Competence | | | | |
| Social Competence | | | | |
| Autonomy | | | | |
| Autonomy | Students can chose independently, in which to courses. | fields they want to deepen their knowle | dge and skills th | rough the election o |
| Workload in Hours | Depends on choice of courses | | | |
| Credit points | 6 | | | |
| Assignment for the | Civil Engineering: Specialisation Structural Engineeri | ng: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engine | eering: Elective Compulsory | | |
| _ | Civil Engineering: Specialisation Coastal Engineering | : Elective Compulsory | | |
| | Civil Engineering: Specialisation Water and Traffic: E | | | |
| | Civil Engineering: Specialisation Computational Engin | | | |
| | civir Engineering. Specialisation Computational Engli | neering. Liecuve compuisory | | |

| Course L3092: Design of Composite Bridges | |
|---|---|
| Тур | Integrated Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Examination Form | Klausur |
| Examination duration and | 90 min |
| scale | |
| Lecturer | Prof. Marcus Rutner |
| Language | DE |
| Cycle | SoSe |
| Content | |
| Literature | |

| Course L1867: Analysis of Of | fshore Structures |
|------------------------------|---|
| Тур | Lecture |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | Mündliche Prüfung |
| Examination duration and | 30 min |
| scale | |
| | Dr. Said Fawad Mohammadi |
| Language | |
| Cycle | |
| Content | Topic 1: Types of Offshore Structures, Fixed and floating structures for Oil & Gas and Offshore Wind industry |
| | Topic 2: Wave Forces, Morisons equation |
| | Topic 3: Irregular Seastates, Power spectrum and application of FFT |
| | Topic 4: Additional Environmental Forces, wind spectra, current forces |
| | Topic 5: Linear-Time-Invariant Systems, response of an LTI-system in frequency domain |
| | Topic 6: Tubular Welded Connections, stress concentration factors, weld geometry |
| | Topic 7: Introduction to Fracture Mechanics, criteria for fracture initiation and crack growth |
| | Topic 8: Time and Frequency Domain Fatigue Analyses, rainflow counting, application of LTI-systems for frequency domain fatigue |
| | Topic 9: Offshore Installation and Exam, installation of structures, pile driving, pipe laying techniques |
| Literature | Chakrabarti, Handbook of Offshore Engineering, 2005 |
| | Sarpkaya, Wave Forces on Offshore Structures, 2010 |
| | Faltinsen, Sea Loads on Ships and Offshore Structures, 1998 |
| | Sorensen, Basic Coastal Engineering, 2006 |
| | Dowling, Mechanical Behavior of Materials, 2007 |
| | Haibach, Betriebsfestigkeit, 2006 |
| | Marshall, Design of Welded Tubular Connections, 1992 |
| | Newland, Random vibrations, spectral and wavelet analysis, 1993 |
| | |

| Course L3227: Energy Geotechnics | | |
|----------------------------------|---|--|
| Тур | Lecture | |
| Hrs/wk | 3 | |
| СР | 3 | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | |
| Examination Form | Schriftliche Ausarbeitung (laut FPrO) | |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt | |
| scale | | |
| Lecturer | Pauline Kaminski | |
| Language | DE/EN | |
| Cycle | WiSe | |
| Content | Energy geotechnics is a young field in geotechnical engineering with the aim of developing sustainable geotechnical solutions for future-oriented issues relating to the production, transport, operation, decommissioning, and waste utilisation of various energy sources. Examples of possible fields of activity in energy geotechnics include geothermal energy and thermally activated foundation components, foundations for onshore and offshore wind turbines, the decommissioning of mining facilities and the handling of waste products from fossil fuels such as tailings and the geological storage of CO2. Relevant soil mechanical processes in these applications include the thermo-hydro-mechanically coupled behaviour of soils, multiphase flow in porous media and partially saturated soils. The lecture gives an overview of various aspects of energy geotechnics and provides in-depth knowledge of the associated soil mechanical processes. In addition, CO2-scarce geotechnical applications are discussed and emission estimates as well as the optimisation of geotechnical structures according to sustainability aspects are addressed. | |
| Literature | | |

| Course L0052: Solid Matter F | Process Technology for Biomass |
|------------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Examination Form | Klausur |
| Examination duration and | 60 min |
| scale | |
| Lecturer | Prof. Werner Sitzmann |
| Language | DE |
| Cycle | SoSe |
| Content | The industrial application of unit operations as part of process engineering is explained by actual examples of solid biomass |
| | processes. Size reduction, transportation and dosing, drying and agglomeration of renewable resources are described as important |
| | unit operations when producing solid fuels and bioethanol, producing and refining edible oils, when making Btl - and WPC - |
| | products. Aspects of explosion protection and plant design complete the lecture. |
| Literature | Kaltschmitt M., Hartmann H. (Hrsg.): Energie aus Bioamsse, Springer Verlag, 2001, ISBN 3-540-64853-4 |
| | Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz, Schriftenreihe Nachwachsende Rohstoffe, |
| | Fachagentur Nachwachsende Rohstoffe e.V. www.nachwachsende-rohstoffe.de |
| | Bockisch M.: Nahrungsfette und -öle, Ulmer Verlag, 1993, ISBN 380000158175 |
| | |

| Course L1634: Forum I - Geotechnics and Construction Management | |
|---|---|
| Тур | Seminar |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | Mündliche Prüfung |
| Examination duration and | 30 min |
| scale | |
| Lecturer | Prof. Jürgen Grabe |
| Language | DE |
| Cycle | WiSe |
| Content | Lectures about projects and issues with practical and scientific relevance. |
| Literature | |

| Course L1635: Forum II - Geotechnics and Construction Management | |
|--|---|
| Тур | Seminar |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | Mündliche Prüfung |
| Examination duration and | 30 min |
| scale | |
| Lecturer | Prof. Jürgen Grabe |
| Language | DE |
| Cycle | SoSe |
| Content | Lectures about projects and issues with practical and scientific relevance. |
| Literature | |

| Course L1151: Timber Structures | |
|---------------------------------|---|
| Тур | Seminar |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Examination Form | Referat |
| Examination duration and | 90 min |
| scale | |
| Lecturer | Prof. Torsten Faber |
| Language | DE |
| Cycle | WiSe |
| Content | |
| Literature | |

| Course L2666: Innovative Timber Construction | | |
|--|--|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 4 | |
| Workload in Hours | Independent Study Time 92, Study Time in Lecture 28 | |
| Examination Form | Schriftliche Ausarbeitung | |
| Examination duration and | 45 Minuten | |
| scale | | |
| Lecturer | Dr. Andreas Meisel | |
| Language | DE | |
| Cycle | WiSe | |
| Content | | |
| Literature | - Blass, J.: "Ingenieurholzbau" | |
| | - Schickhofer, G.: "BSPhandbuch: Holz-Massivbauweise in Brettsperrholz" | |
| | - Informationsdienst Holz: div. Merkblätter und Broschüren | |
| | - Wallner-Novak M.: Brettsperrholz Bemessung, Band 1 und 2 | |
| | - Gerner M.: "Fachwerk: Entwicklung, Instandsetzung, Neubau" | |
| | - Meisel, A.: "Historische Dachwerke: Beurteilung, realitätsnahe statische Analyse und Instandsetzung" | |
| | - Kempe K.: "Dokumentation Holzschädlinge" | |
| | - Huckfeldt T.: "Hausfäule- und Bauholzpilze" | |

| Course L1152: Glass Structures | |
|--------------------------------|--|
| Тур | Lecture |
| Hrs/wk | |
| СР | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Examination Form | Mündliche Prüfung |
| Examination duration and | |
| scale | |
| Lecturer | Marvin Matzik |
| Language | DE |
| Cycle | WiSe |
| Content | Glass structures |
| | - Introduction of the material glass (production, refinement, material characteristic) |
| | - design of facades |
| | - facade types |
| | - static calculation of glazing |
| | - static calculation of facades |
| | - load bearing behavior of glazing (plate or membrane stiffness) |
| | - vertical / horizontal glazing with safety-related requirements |
| | - glass structures |
| | - fire safety of glass facades |
| | - construction physics of facades and glazing |
| Literature | |

| Course L1447: Glass Structures | |
|--------------------------------|---|
| Тур | Recitation Section (large) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | Mündliche Prüfung |
| Examination duration and | |
| scale | |
| Lecturer | Marvin Matzik |
| Language | DE |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L3270: Sustainable la | andfill design and operation |
|------------------------------|--|
| Тур | Integrated Lecture |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Examination Form | Klausur |
| Examination duration and | 60 min |
| scale | |
| Lecturer | Dr. Marco Ritzkowski |
| Language | EN |
| Cycle | SoSe |
| Content | The course introduces the development of modern waste resource management and demonstrates the importance of landfills in the context of recycling processes. Based on international (EU) and national legislation, the current landfill situation is presented and the future significance of landfills will be discussed. A central element of the course deals with the main transformation processes in the landfilled waste, the emission of gases and leachate, the long-term behaviour of landfills as well as aftercare and after-utilisation measures. Further focal points of the course are measures for the sustainable reduction of environmentally and climate-damaging emissions and aspects of landfill technology in an international context. |
| Literature | Waste Management. Bernd Bilitewski; Georg Härdtle; Klaus Marek (Eds.), ISBN: 9783540592105, Springer Verlag Lehrbuchsammlung der TUB, Signatur USH-305 Solid Waste Technology and Management. Thomas Christensen (Ed.), ISBN: 978-1-4051-7517-3, Wiley Verlag Lesesaal 2: US - Umweltschutz, Signatur USH-332 Solid Waste Landfilling - Concepts, Processes, Technologies. Cossu, R. and Stegmann, R. (Eds.), ISBN: 978-0-12-818336-6 PDF (Volltext) über TUB |

| Course L3091: Special Topics in Steel Design | |
|--|---|
| Тур | Integrated Lecture |
| Hrs/wk | 2 |
| CP | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Examination Form | Klausur |
| Examination duration and | 90 min |
| scale | |
| Lecturer | Prof. Marcus Rutner, Nikolay Lalkovski |
| Language | DE |
| Cycle | SoSe |
| Content | |
| Literature | |

| Course L2378: Special topics of civil engineering 1CP | |
|---|---|
| Тур | |
| Hrs/wk | 1 |
| CP | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Examination Form | Fachtheoretisch-fachpraktische Arbeit |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt |
| scale | |
| Lecturer | Dozenten des SD B |
| Language | DE |
| Cycle | WiSe/SoSe |
| Content | The course occurs only if required. The content is defined at short notice. |
| Literature | Die Literatur wird kurzfristig festgelegt. |

| Course L2379: Special topics of civil engineering 2 LP | | |
|--|---|--|
| Тур | | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Examination Form | Fachtheoretisch-fachpraktische Arbeit | |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt | |
| scale | | |
| Lecturer | Dozenten des SD B | |
| Language | DE | |
| Cycle | WiSe/SoSe | |
| Content | The course occurs only if required. The content is defined at short notice. | |
| Literature | Die Literatur wird kurzfristig festgelegt. | |

| Course L2380: Special topics of civil engineering 3 LP | |
|--|---|
| Тур | |
| Hrs/wk | 3 |
| CP | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Examination Form | Fachtheoretisch-fachpraktische Arbeit |
| Examination duration and | wird zu Beginn der Lehrveranstaltung festgelegt |
| scale | |
| Lecturer | Dozenten des SD B |
| Language | DE |
| Cycle | WiSe/SoSe |
| Content | The course occurs only if required. The content is defined at short notice. |
| Literature | Die Literatur wird kurzfristig festgelegt. |

| Course L2789: Structural Design | | |
|---------------------------------|---|--|
| Тур | Seminar | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Examination Form | Mündliche Prüfung | |
| Examination duration and | 20 min | |
| scale | | |
| Lecturer | Dr. Jan Mittelstädt | |
| Language | DE/EN | |
| Cycle | SoSe | |
| Content | | |
| Literature | [1] Structure Systems by Heino Engel, Hantje Cantz, 3rd edition (Feb 2007), ISBN-10: 3775718761 | |
| | Form and Force, Designing Efficient, Expressive Structures by Allan, E., Zalewski, W. et al, John Wiley and | |
| | Sons; 1st edition (Sept 2009), ISBN-10: 047017465X | |
| | [2] Peter Rice: An Engineer Imagines, ISBN-10 : 1849944237 | |
| | [3] Konrad Wachsmann and the Grapevine Structure by C. Sumi et al., Park Books (Oct 2018), ISBN-10: | |
| | 9783038601104 | |
| | [4] Manual of Multi-Story Timber Construction by Hermann Kaufmann, Stefan Krotsch, Stefan Winter, DETAIL, | |
| | (June 2018), ISBN-10: 3955533948 | |
| | [5] The Art of Structural Design: A Swiss Legacy by B. Billington, Princeton University Art Museum; First Edition | |
| | edition (Mar 2003), ISBN-10: 0300097867 | |
| | [6] Structured Lineages: Learning from Japanese Structural Design by G. Nordenson et al, The Museum of | |
| | Modern Art (Jul 2019), ISBN-10: 1633450562 | |
| | [7] The Structure: Works of Mahendra Raj by V. Mehta, R. Mehndiretta, A. Huber, Park Books (Oct 2015), | |
| | ISBN-10: 3038600253 | |
| | | |
| | | |
| | | |

| Module M0802: Memb | orane Technology | | | |
|-----------------------------|--|--|-------------------|-----------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Membrane Technology (L0399) | | Lecture | 2 | 3 |
| Membrane Technology (L0400) | | Recitation Section (small) | 1 | 2 |
| Membrane Technology (L0401) | | Practical Course | 1 | 1 |
| Module Responsible | | | | |
| Admission Requirements | None | <u></u> | | |
| | Basic knowledge of water chemistry. Knowledge o | f the core processes involved in water, gas | and steam treat | ment |
| Knowledge | After taking part successfully, students have reach | and the following learning results | | |
| | Arter taking part successfully, students have reach | led the following learning results | | |
| Professional Competence | Students will be able to rank the technical applica | tions of industrially important mombrane n | racassas Thous | vill be able to evola |
| Kilowieuge | the different driving forces behind existing mem | | | |
| | membrane filtration and their advantages and di | | | |
| | membranes in water, other liquid media, gases an | • | iani the key unit | erences in the use |
| | ······································ | | | |
| Skills | Students will be able to prepare mathematical ed | | | |
| | calculate key parameters in the membrane separ | | | |
| | available boundary data and provide recommen- | | | 5 |
| | experiments, students will be able to classify t | | | |
| | membrane materials. Students will be able to char | racterise the formation of the fouling layer i | n different water | 's and apply technic |
| | measures to control this. | | | |
| Personal Competence | | | | |
| Social Competence | Students will be able to work in diverse teams on tasks in the field of membrane technology. They will be able to make decisions | | | |
| | within their group on laboratory experiments to be | e undertaken jointly and present these to ot | hers. | |
| Autonomy | Students will be in a position to solve homework | on the topic of membrane technology in | dopondoptly. The | w will be capable |
| Autonomy | finding creative solutions to technical questions. | t on the topic of membrane technology in | dependentiy. The | ey will be capable |
| | internet questions. | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lectu | re 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | | | | |
| | 90 min | | | |
| scale | | | | |
| - | Civil Engineering: Specialisation Water and Traffic: | | | |
| Following Curricula | Bioprocess Engineering: Specialisation A - General | | - | |
| | Bioprocess Engineering: Specialisation B - Industri | | - | |
| | Chemical and Bioprocess Engineering: Specialisati | | | |
| | Chemical and Bioprocess Engineering: Specialisati | • • | | |
| | Chemical and Bioprocess Engineering: Technical C | | | |
| | Environmental Engineering: Specialisation Water (| | npulsory | |
| | Process Engineering: Specialisation Process Engine | | | |
| | Process Engineering: Specialisation Environmental | | | |
| | Water and Environmental Engineering: Specialisat | | | |
| | Water and Environmental Engineering: Specialisat | | | |
| | Water and Environmental Engineering: Specialisat | ion clues: Elective Compulsory | | |

| Course L0399: Membrane Te | chnology |
|---------------------------|--|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 3 |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 |
| Lecturer | Prof. Mathias Ernst |
| Language | EN |
| Cycle | WiSe |
| | The lecture on membrane technology supply provides students with a broad understanding of existing membrane treatment processes, encompassing pressure driven membrane processes, membrane application in electrodialyis, pervaporation as well as membrane distillation. The lectures main focus is the industrial production of drinking water like particle separation or desalination; however gas separation processes as well as specific wastewater oriented applications such as membrane bioreactor systems will be discussed as well. Initially, basics in low pressure and high pressure membrane applications are presented (microfiltration, ultrafiltration, nanofiltration, reverse osmosis). Students learn about essential water quality parameter, transport equations and key parameter for pore membrane as well as solution diffusion membrane systems. The lecture sets a specific focus on fouling and scaling issues and provides knowledge on methods how to tackle with these phenomena in real water treatment application. A further part of the lecture deals with the character and manufacturing of different membrane materials and the characterization of membrane material by simple methods and advanced analysis. The functions, advantages and drawbacks of different membrane housings and modules are explained. Students learn how an industrial membrane application is designed in the succession of treatment steps like pre-treatment, water conditioning, membrane integration and post-treatment of water. Besides theory, the students will be provided with knowledge on membrane demo-site examples and insights in industrial practice. |
| Literature | T. Melin, R. Rautenbach: Membranverfahren: Grundlagen der Modul- und Anlagenauslegung (2., erweiterte Auflage), Springer-Verlag, Berlin 2004. Marcel Mulder, Basic Principles of Membrane Technology, Kluwer Academic Publishers, Dordrecht, The Netherlands Richard W. Baker, Membrane Technology and Applications, Second Edition, John Wiley & Sons, Ltd., 2004 |

| Course L0400: Membrane Technology | |
|-----------------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| CP | 2 |
| Workload in Hours | Independent Study Time 46, Study Time in Lecture 14 |
| Lecturer | Prof. Mathias Ernst |
| Language | EN |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| Course L0401: Membrane Te | ourse L0401: Membrane Technology | |
|---------------------------|--|--|
| Тур | Practical Course | |
| Hrs/wk | 1 | |
| СР | 1 | |
| Workload in Hours | ependent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Prof. Mathias Ernst | |
| Language | EN | |
| Cycle | ViSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| problem-based Learning | | |
|--|----------------|---|
| | Hrs/wk 4 | CP 6 |
| | | |
| | | |
| n | | |
| ng results | | |
| cle | | |
| f needs for action ation measures ation approaches, meth | nods, numeric | al models, plannir |
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| nd subsequent discussio | on. The work | on the complex tas |
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| y oulsory ory tive Compulsory npulsory | | |
| o t | ive Compulsory | ive Compulsory pulsory e Compulsory |

| Course L2926: Sustainable N | lature-based Coastal Protection in a Changing Climate (SeaPiaC) |
|-----------------------------|---|
| Тур | Project-/problem-based Learning |
| Hrs/wk | 4 |
| СР | 6 |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 |
| Lecturer | Prof. Peter Fröhle |
| Language | EN |
| Cycle | WiSe |
| Content | Climate and Climate Change General Impacts of Climate Change on Wind Regime and Water Cycle Consequences of Climate Change for Coastal Processes Coastal Protection in Taiwan and Germany Fundamentals of Climate Adaptation Nature-Based Solutions (NBS) for Coastal Protection |
| Literature | Materials provided on eLearning Platform (HOOU Platform) Depending on the main topics of the course in the respective year, the literature (recent papers) will be provided in the course-material or via StudIP. |

| Typ Hrs/wk CP draulic engineering (L2291) Project-/problem-based Learning 6 Prof. Peter Fröhle 6 |
|--|
| |
| None |
| |
| Hydrology, Hydraulic Engineering Hydromechanic, Hydraulics Fundamentals of Coastal Engineering, Coastal- and Flood Protection Hydrological Systems |
| After taking part successfully, students have reached the following learning results |
| Climate protection and climate adaptation Insights into climate change and its regional characteristics - fundamentals, climate modelling / climate models Impacts of climate change on the components of the regional hydrological cycle Fundamentals of analysis of climate data Consequences of the impact of the climate change Measures for climate adaptation Assessment, prioritization and communication of adaptation measures Fundamentals of the analysis of hydrometeorological and hydrological data Critical thinking: analysis of processes and relations, assessment of needs for action Creative thinking: development of adaptation strategies and adaptation measures Practical thinking: inclusion of restrictions, application of calculation approaches, methods, numerical models, planni methods Consideration of complex tasks |
| Working in heterogenous groups Working with different scientific / non-scientific disciplines Self reflection |
| Application oriented use of knowledge and skills Autonomous work on complex tasks |
| Independent Study Time 124, Study Time in Lecture 56 |
| 6 |
| None |
| Written elaboration Preparation of a written report and a presentation of a complex task. |
| Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory |
| Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Water and Environmental Engineering: Specialisation Cities: Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Elective Compulsory |
| |

| Course L2291: Adaptation to | o climate change in hydraulic engineering | | |
|-----------------------------|--|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | | | |
| СР | 6 | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | |
| Lecturer | Prof. Peter Fröhle | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | Climate protection and climate adaptation Findings on climate change and its regional characteristics: fundamentals of climate change, climate modelling / climate models Impacts of climate change on the components of the regional hydrological cycle(climate science view) Fundamentals of the analysis of climate data Concequences of the impacts of climate change (ingenieering science view) Measures for climate change adaptation Assessment, prioritization and communication of measures Fundamentals of analysis of hydrometeorological and hydrological data | | |
| Literature | Wird bereitgestellt über die HOOU - eLearning Plattform abhängig von den jeweils schwerpunktmäßig behandelten Fragestellungen wird das Schrifttum (aktuelle Paper) in der Veranstaltung bzw. über StudiP zur Verfügung gestellt. | | |

| - | | | | |
|---|---|--|------------------------|--------------------|
| Courses | | | | |
| Title | | Тур | Hrs/wk | СР |
| Construction law BGB and VOB - la Construction disputes from constru | ction (excavation) practice (L3182) | Lecture | 2 | 3 3 |
| Module Responsible | | Lecture | L | 5 |
| | None | | | |
| Admission Requirements | | | | |
| Kecommended Previous Knowledge | Complete modules: Geotechnics I-III | | | |
| Educational Objectives | After taking part successfully, students have reach | ad the following learning results | | |
| Professional Competence | After taking part successiony, students have react | led the following learning results | | |
| - | Students will gain knowledge of | | | |
| | the history of civil engineering law, | | | |
| | basics of foundation and civil engineering la | IW, | | |
| | legal aspects of technical regulations in civi | I engineering (with case studies), | | |
| | the civil engineering contract, | | | |
| | the liability of the designer and contractor in | n civil engineering, | | |
| | the subsoil risk and the system risk, | | | |
| | the total debt in (civil) engineering law, | | | |
| | the (construction) conflict, dispute avoidance | | ess, | |
| | the systematics of construction contract law | ν, | | |
| | the BGB construction contract law, | | | |
| | responsibilities on the construction site, | | | |
| | remuneration and contract management, | | | |
| | liability for defects, | | | |
| | public procurement law | | | |
| | Disturbed construction processes: How much | th money am I entitled to? | | |
| | Correct calculation of supplements. | | | |
| Skills | Students learn to apply legal aspects in planning | and construction in a legally balanc | ed way. Students learn | how to use legal a |
| | construction management aspects in practice (pla | | | |
| | to manage the construction project optimally. | J · · · · · , · · · · , | j | |
| | | | | |
| | | | | |
| Personal Competence | | | | |
| Social Competence | Students can work in groups and support each oth | er in finding solutions. | | |
| Autonomy | Students are able to assess their own strengths ar | nd weaknesses and organize their tir | me and learning manage | ement based on th |
| Workload in Hours | Independent Study Time 124, Study Time in Lectu | re 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Oral exam | | | |
| Examination duration and | 30 min | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Engineeri | ng: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Eng | ineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Structural Enginee | ering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Water and Traffic: | Elective Compulsory | | |
| | Civil Engineering: Specialisation Computational En | aineering: Elective Compulsory | | |

| Course L3182: Construction | ourse L3182: Construction law BGB and VOB - law in (excavation) practice | | |
|----------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Prof. Günther Schalk | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | | | |
| Literature | Literatur: | | |
| | - Folienskript (in der Vorlesung erhältlich) | | |
| | - Fuchs/Maurer/Schalk: Handbuch Tiefbaurecht | | |

| Course L3181: Construction | ourse L3181: Construction disputes from construction (excavation) practice | | |
|----------------------------|--|--|--|
| Тур | Lecture | | |
| Hrs/wk | 2 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 62, Study Time in Lecture 28 | | |
| Lecturer | Ingo Junker | | |
| Language | DE | | |
| Cycle | WiSe | | |
| Content | | | |
| Literature | | | |

| Courses | | | | |
|------------------------------------|---|---|----------------|-----------------|
| Title | | Тур | Hrs/wk | СР |
| Scientific Working in Computationa | Engineering (L2764) | Project-/problem-based Learning | 4 | 6 |
| Module Responsible | Prof. Kay Smarsly | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic knowledge in scientific writing. String interest i | n topics related to computing in civil engine | ering. | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have reached | the following learning results | | |
| Professional Competence | | | | |
| | course instructors and in collaboration with each other, the students will also learn to understand the complex process of scientifi thinking, being able to accurately plan, implement and analyze scientific projects, such as prospective master theses. A proje will be conducted throughout the semester, which will contribute to the grade. Since scientific writing is of particular importance this course, a scientific paper will be developed based, which is a prerequisite for the final examination. The paper will be writte based on the project conducted within this course. Project meetings in small groups, presentations, and critical discussions scientific publications are further key activities. The students will be capable (i) of solving a scientific problem following a scientific methodology, (ii) of documenting their wo effectively in the form of a paper, and (iii) of sharing their work in a presentation. | | | |
| Personal Competence | The students will be able to work in a multidisciplina | v team and develop communication skills no | ecessary for p | roblem solving. |
| | The students will be able to work in a multidisciplinary team and develop communication skills necessary for problem solving. The students will be able to extend their knowledge and apply it to solve scientific problems by working independently in a project | | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture | 56 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Written elaboration | | | |
| Examination duration and | 10 pages of work with 15-minute oral presentation | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Water and Traffic: Elective Compulsory | | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical Engine | ering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Coastal Engineering | Elective Compulsory | | |
| | Civil Engineering: Specialisation Structural Engineering | ng: Elective Compulsory | | |
| | Civil Engineering: Specialisation Computational Engir | eering: Elective Compulsory | | |
| | Computer Science: Specialisation II: Intelligence Engi | neering: Elective Compulsory | | |

| Course L2764: Scientific Wor | ourse L2764: Scientific Working in Computational Engineering | | |
|------------------------------|--|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 4 | | |
| СР | 6 | | |
| Workload in Hours | Independent Study Time 124, Study Time in Lecture 56 | | |
| Lecturer | Prof. Kay Smarsly | | |
| Language | EN | | |
| Cycle | WiSe/SoSe | | |
| Content | In the course, a scientific problem of practical relevance will first be defined, taking into account the interests of the students participating in the course. The scientific problem will then systematically be solved within the framework of a comprehensive project. The principles of scientific working will be taught based on the scientific problem defined previously. As an integral part of scientific working, fundamentals of scientific writing will be presented and applied to a scientific paper to be written during the course. Topics related to scientific writing include structuring in scientific writing (structuring the abstract, the introduction, the main part, the summary and conclusions, and the acknowledgments and references) and recommendations on effective scientific writing (principles of composition, use of English in scientific writing, useful tips, creating figures, writing in mathematics, referencing, and formal email correspondence). A final paper and a final presentation will be assembled by the students. | | |
| Literature | Smarsly, K. & Dragos, K., 2019. Scientific Writing in Engineering. Tredition, Hamburg, Germany. | | |

| Courses | | | | |
|-----------------------------------|---|--|-----------------------|----------------------|
| Title | | Tur | Line /ucl- | СР |
| Modeling of Subsurface Processes | (12731) | Typ Recitation Section (small) | Hrs/wk 3 | 3 |
| Subsurface Solute Transport (L272 | | Lecture | 2 | 2 |
| Subsurface Solute Transport (L272 | | Recitation Section (large) | 1 | 1 |
| Module Responsible | Prof. Nima Shokri | | | |
| Admission Requirements | None | | | |
| Recommended Previous | Basic Mathematics, Hydrology | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students h | ave reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | Upon completion of this module, the st | udents will understand the mechanisms contro | olling solute transpo | rt in soil and natu |
| | porous media and will be able to work wi | th the equations that govern the fate and transp | ort of solutes in por | ous media. Analytic |
| | numerical and experimental tools and te | chniques will be used in this module. | | |
| | | | | |
| Skills | | tudents will be exposed to analytical, experimer | | |
| | | excellent opportunity to improve their skills on r | nultiple fronts which | will be useful in th |
| | future career. | | | |
| Personal Competence | | | | |
| | Teamwork & problem solving | | | |
| Autonomy | | | | |
| | willingness to work independently and re | sponsibly. | | |
| | Independent Study Time 96, Study Time | in Lecture 84 | | |
| Credit points | 6 | | | |
| Course achievement | None | | | |
| Examination | Subject theoretical and practical work | | | |
| Examination duration and | Report | | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Structur | al Engineering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotech | nical Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Coastal | Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Water and | nd Traffic: Elective Compulsory | | |
| | Civil Engineering: Specialisation Compute | ational Engineering: Elective Compulsory | | |
| | Chemical and Bioprocess Engineering: Te | echnical Complementary Course: Elective Compu | lsory | |
| | Environmental Engineering: Core Qualific | ation: Compulsory | | |
| | Process Engineering: Specialisation Envir | onmental Process Engineering: Elective Compuls | sory | |
| | Process Engineering: Specialisation Proce | ess Engineering: Elective Compulsory | | |
| | Water and Environmental Engineering: S | pecialisation Water: Compulsory | | |
| | Water and Environmental Engineering: S | | | |

| Course L2731: Modeling of S | ubsurface Processes |
|-----------------------------|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 3 |
| СР | 3 |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 |
| Lecturer | Dr. Milad Aminzadeh |
| Language | EN |
| Cycle | WiSe |
| Content | Basic usage and background of chosen computer software to calculate flow and transport in the saturated and unsaturated zone and to analyze field data like pumping test data |
| Literature | |

| Course L2728: Subsurface So | olute Transport |
|-----------------------------|---|
| Тур | Lecture |
| Hrs/wk | 2 |
| СР | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Nima Shokri |
| Language | EN |
| Cycle | WiSe |
| Content | Basic physical properties of soil: Definition and quantification; Liquid flow in soils (Darcy's law); Solute transport in soils; Practical analysis to measure dispersion coefficient in soil under different boundary conditions; Advanced topics (e.g. Application of Artificial Intelligence to predict soil salinization) |
| Literature | - Environmental Soil Physics, by Daniel Hillel - Soil Physics, Sixth Edition, by William A. Jury and Robert Horton |

| Course L2729: Subsurface Solute Transport | | |
|---|---|--|
| Тур | Recitation Section (large) | |
| Hrs/wk | 1 | |
| CP | 1 | |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 | |
| Lecturer | Hannes Nevermann | |
| Language | EN | |
| Cycle | WiSe | |
| Content | See interlocking course | |
| Literature | See interlocking course | |

| Courses | | | | |
|-----------------------------------|---|--|---------------|-----------------|
| Title | | Тур | Hrs/wk | СР |
| Waste and Environmental Chemist | | Practical Course | 2 | 2 |
| Biological Waste Treatment (L0318 | | Project-/problem-based Learning | 3 | 4 |
| Module Responsible | | | | |
| Admission Requirements | None | | | |
| | chemical and biological basics | | | |
| Knowledge | | | | |
| Educational Objectives | After taking part successfully, students have | reached the following learning results | | |
| Professional Competence | | | | |
| Knowledge | design and layout of anaerobic and aerobic w | ing the planning of biological waste treatment plant raste treatment plants in detail, describe different te nd explain different methods for waste analytics. | | |
| Skills | The students are able to discuss the compilation of design and layout of plants. They can critically evaluate techniques and quali control measurements. The students can recherché and evaluate literature and date connected to the tasks given in der modu and plan additional tests. They are capable of reflecting and evaluating findings in the group. | | | |
| Personal Competence | | | | |
| | Students can participate in subject-specific a | and interdisciplinary discussions, develop cooperate | d solutions a | nd defend their |
| | | the scientific development in front of colleagues. | | |
| Autonomy | Students can independently tap knowledge from literature, business or test reports and transform it to the course projects. Th are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define furth steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with the potential social, economic and cultural impact. | | | |
| Workload in Hours | Independent Study Time 110, Study Time in L | Lecture 70 | | |
| Credit points | | | | |
| Course achievement | Compulsory Bonus Form | Description | | |
| course demovement | Yes None Subject theoretical | and | | |
| | practical work | | | |
| Examination | Presentation | | | |
| Examination duration and | Elaboration and Presentation (15-25 minutes | in groups) | | |
| scale | | | | |
| Assignment for the | Civil Engineering: Specialisation Coastal Engir | neering: Elective Compulsory | | |
| Following Curricula | Civil Engineering: Specialisation Geotechnical | Engineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Structural En | gineering: Elective Compulsory | | |
| | Civil Engineering: Specialisation Water and Tr | affic: Elective Compulsory | | |
| | Bioprocess Engineering: Specialisation A - Ge | neral Bioprocess Engineering: Elective Compulsory | | |
| | Chemical and Bioprocess Engineering: Specia | lisation General Process Engineering: Elective Comp | oulsory | |
| | Chemical and Bioprocess Engineering: Specia | lisation Bioprocess Engineering: Elective Compulsor | у | |
| | Chemical and Bioprocess Engineering: Specia | lisation Chemical Process Engineering: Elective Com | npulsory | |
| | Chemical and Bioprocess Engineering: Specia | lisation Chemical and Bio process Engineering: Elec | tive Compuls | ory |
| | Environmental Engineering: Core Qualification | n: Compulsory | | |
| | International Management and Engineering: S | Specialisation II. Renewable Energy: Elective Compu | lsory | |
| | Process Engineering: Specialisation Environm | ental Process Engineering: Elective Compulsory | | |
| | Water and Environmental Engineering: Specia | alisation Cities: Elective Compulsory | | |
| | | | | |

| Course L0328: Waste and En | vironmental Chemistry |
|----------------------------|--|
| Тур | Practical Course |
| Hrs/wk | 2 |
| CP | 2 |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 |
| Lecturer | Prof. Kerstin Kuchta |
| Language | EN |
| Cycle | WiSe |
| Content | The participants are divided into groups. Each group prepares a transcript on the experiment performed, which is then used as basis for discussing the results and to evaluate the performance of the group and the individual student. In some experiments the test procedure and the results are presented in seminar form, accompanied by discussion and results evaluation. Experiments ar e.g. Screening and particle size determination Fos/Tac AAS Chalorific value |
| Literature | Scripte |

| Course L0318: Biological Waste Treatment | | |
|--|---|--|
| Тур | Project-/problem-based Learning | |
| Hrs/wk | 3 | |
| СР | 4 | |
| Workload in Hours | Independent Study Time 78, Study Time in Lecture 42 | |
| Lecturer | Prof. Kerstin Kuchta | |
| Language | EN | |
| Cycle | WiSe | |
| Content | Introduction biological basics determination process specific material characterization aerobic degradation (Composting, stabilization) anaerobic degradation (Biogas production, fermentation) Technical layout and process design Flue gas treatment Plant design practical phase | |
| Literature | | |

| Courses | | | | |
|--|--|---|-----------------|-------------------|
| | | | | |
| Title | | Typ | Hrs/wk | СР |
| Planning of waste treatment plants (L3267) Recycling technologies and thermal waste treatment (L3265) | | Project-/problem-based Learning Lecture | 3 2 | 3 2 |
| Recycling technologies and thermal waste treatment (L3265) Recycling technologies and thermal waste treatment (L3266) | | Recitation Section (small) | 1 | 1 |
| Module Responsible | | | | |
| Admission Requirements | | | | |
| Recommended Previous | | | | |
| Knowledge | Basics of thermo dynamics | | | |
| kilomeuge | Basics of fluid dynamics | | | |
| | fluid dynamics chemistry | | | |
| 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 | The students can name describe surrent issue and r | replane in the field of waste treatment (n | achanical ch | optical and there |
| Knowledge | The students can name, describe current issue and p and contemplate them in the context of their field. | roblems in the field of waste treatment (in | iechanical, ch | |
| | and contemplate them in the context of their field. | | | |
| | The industrial application of unit operations as part of | process engineering is explained by actual | examples of | waste technologi |
| | Compostion, particle sizes, transportation and dosing | of wastes are described as important unit o | perations . | |
| | Students will be able to design and design waste trea | tment technology equipment. | | |
| Skills | The students are able to select suitable processes for | the treatment of wastes or raw material w | with respect to | their characteris |
| Skills | and the process aims. They can evaluate the efforts a | | | |
| | and the process and. They can evaluate the enorts a | | uny reasone e | |
| Personal Competence | | | | |
| Social Competence | e Students can | | | |
| | respectfully work together as a team and discu | ss technical tasks | | |
| | participate in subject-specific and interdisciplin | | | |
| | develop cooperated solutions | | | |
| | promote the scientific development and accep | professional constructive criticism. | | |
| | h | | | |
| Autonomy | Students can independently tap knowledge of the | e subject area and transform it to new | questions. Th | ney are capable |
| | consultation with supervisors, to assess their learnin | | | |
| | targets for new application-or research-oriented dutie | s in accordance with the potential social, ec | conomic and c | ultural impact. |
| Workload in Hours | Independent Study Time 96, Study Time in Lecture 84 | | | |
| Credit points | | | | |
| Course achievement | None | | | |
| Examination | Examination Written exam | | | |
| Examination duration and | | | | |
| scale | | | | |
| | Civil Engineering: Specialisation Water and Traffic: Ele | ctive Compulsory | | |
| Following Curricula | | | | |
| | Chemical and Bioprocess Engineering: Specialisation | | oulsory | |
| | Chemical and Bioprocess Engineering: Specialisation I | | | |
| | Chemical and Bioprocess Engineering: Specialisation | | - | |
| | Chemical and Bioprocess Engineering: Specialisation | Chemical and Bio process Engineering: Elec | tive Compulso | ory |
| | Environmental Engineering: Specialisation Energy and | | | |
| | International Management and Engineering: Specialis | ation II. Renewable Energy: Elective Compu | lsory | |
| | Renewable Energies: Specialisation Bioenergy System | s: Elective Compulsory | | |
| | Process Engineering: Specialisation Chemical Process | Engineering: Elective Compulsory | | |
| | Process Engineering: Specialisation Process Engineeri | ng: Elective Compulsory | | |
| | Process Engineering: Specialisation Environmental Pro | cess Engineering: Elective Compulsory | | |
| | Water and Environmental Engineering: Specialisation | Environment: Compulsory | | |
| | Water and Environmental Engineering: Specialisation | Cities: Elective Compulsory | | |

| Course L3267: Planning of w | ourse L3267: Planning of waste treatment plants | | |
|-----------------------------|---|--|--|
| Тур | Project-/problem-based Learning | | |
| Hrs/wk | 3 | | |
| СР | 3 | | |
| Workload in Hours | Independent Study Time 48, Study Time in Lecture 42 | | |
| Lecturer | Prof. Rüdiger Siechau | | |
| Language | EN | | |
| Cycle | WiSe | | |
| Content | The focus is on getting to know the organization and practice of waste management companies. Topics such as planning, financing and logistics will be discussed and there will be an excursion (waste incineration plant, vehicle fleet and collection systems / containers). Project based learning: You will be given a task to work on independently in groups of 4 to 6 students. All tools and data needed for the project work will be discussed in the lecture "Recycling Technologies and Thermal Waste Treatment". Course documents can be downloaded from StudIP. Communication during the project work also takes place via StudIP. | | |
| Literature | Einführung in die Abfallwirtschaft; Martin Kranert, Klaus Cord-Landwehr (Hrsg.); Vieweg + Teubner Verlag; 2010 PowerPoint Präsentationen in Stud IP | | |

| Course L3265: Recycling technologies and thermal waste treatment | | |
|--|---|--|
| Тур | Lecture | |
| Hrs/wk | 2 | |
| СР | 2 | |
| Workload in Hours | Independent Study Time 32, Study Time in Lecture 28 | |
| Lecturer | Prof. Kerstin Kuchta | |
| Language | EN | |
| Cycle | WiSe | |
| Content | Introduction, actual state-of-the-art of waste incineration, aims. legal background, reaction principals basics of incineration processes: waste composition, calorific value, calculation of air demand and flue gas composition Incineration techniques: grate firing, ash transfer, boiler Flue gas cleaning: Volume, composition, legal frame work and emission limits, dry treatment, scrubber, de-nox techniques, dioxin elimination, Mercury elimination Ash treatment: Mass, quality, treatment concepts, recycling, disposal | |
| Literature | Thomé-Kozmiensky, K. J. (Hrsg.): Thermische Abfallbehandlung Bande 1-7. EF-Verlag für Energie- und Umwelttechnik, Berlin, 196 - 2013. | |

| ourse L3266: Recycling technologies and thermal waste treatment | |
|---|---|
| Тур | Recitation Section (small) |
| Hrs/wk | 1 |
| СР | 1 |
| Workload in Hours | Independent Study Time 16, Study Time in Lecture 14 |
| Lecturer | Prof. Kerstin Kuchta |
| Language | EN |
| Cycle | WiSe |
| Content | See interlocking course |
| Literature | See interlocking course |

| | Thesis | | |
|--|---|--|--|
| Modulo M1801: Maste | er thesis (dual study program) | | |
| Module M1001. Mast | | | |
| Courses | | | |
| Title | Typ Hrs/wk CP | | |
| | Professoren der TUHH | | |
| Admission Requirements Recommended Previous | | | |
| Knowledge | | | |
| Educational Objectives | After taking part successfully, students have reached the following learning results | | |
| Professional Competence | | | |
| Knowledge | Dual students | | |
| | use the specialised knowledge (facts, theories and methods) from their field of study and the acquired profession knowledge confidently to deal with technical and practical professional issues. can explain the relevant approaches and terminologies in depth in one or more of their subject's specialist area describe current developments and take a critical stance. formulate their own research assignment to tackle a professional problem and contextualise it within their subject are They ascertain the current state of research and critically assess it. | | |
| Skills | Dual students | | |
| | can select suitable methods for the respective subject-related professional problem, apply them and develop them further as required. assess knowledge and methods acquired during their studies (including practical phases) and apply their expertise to complex and/or incompletely defined problems in a solution- and application-oriented manner. acquire new academic knowledge in their subject area and critically evaluate it. | | |
| Personal Competence | | | |
| Social Competence | Dual students | | |
| Autonomy | can present a professional problem in the form of an academic question in a structured, comprehensible and factual correct manner, both in writing and orally, for a specialist audience and for professional stakeholders. answer questions as part of a professional discussion in an expert, appropriate manner. They represent their own poin of view and assessments convincingly. y Dual students | | |
| | can structure their own project into work packages, work through them at an academic level and reflect on them wirregard to feasible courses of action for professional practice. work in-depth in a partially unknown area within the discipline and acquire the information required to do so. apply the techniques of academic work comprehensively in their own research work when dealing with an operation problem and question. | | |
| Workload in Hours | Independent Study Time 900, Study Time in Lecture 0 | | |
| Credit points | | | |
| Course achievement | | | |
| Examination Examination duration and | According to General Regulations | | |
| scale | | | |
| - | Civil Engineering: Thesis: Compulsory | | |
| Following Curricula | Bioprocess Engineering: Thesis: Compulsory Chemical and Bioprocess Engineering: Thesis: Compulsory | | |
| | Chemical and Bioprocess Engineering: Thesis: Compulsory | | |
| | Computer Science: Thesis: Compulsory | | |
| | Data Science: Thesis: Compulsory | | |
| | Electrical Engineering: Thesis: Compulsory Energy Systems: Thesis: Compulsory | | |
| | Environmental Engineering: Thesis: Compulsory | | |
| | Aircraft Systems Engineering: Thesis: Compulsory | | |
| | Computer Science in Engineering: Thesis: Compulsory Information and Communication Systems: Thesis: Compulsory | | |
| | International Management and Engineering: Thesis: Compulsory | | |
| | Logistics, Infrastructure and Mobility: Thesis: Compulsory | | |
| | Aeronautics: Thesis: Compulsory Materials Science and Engineering: Thesis: Compulsory | | |
| | Materials Science: Thesis: Compulsory | | |
| | Mechanical Engineering and Management: Thesis: Compulsory | | |
| | Mechatronics: Thesis: Compulsory Biomedical Engineering: Thesis: Compulsory | | |
| | · · · · · · · · · · · · · · · · · · · | | |

| Microelectronics and Microsystems: Thesis: Compulsory |
|---|
| Product Development, Materials and Production: Thesis: Compulsory |
| Renewable Energies: Thesis: Compulsory |
| Naval Architecture and Ocean Engineering: Thesis: Compulsory |
| Theoretical Mechanical Engineering: Thesis: Compulsory |
| Process Engineering: Thesis: Compulsory |
| Water and Environmental Engineering: Thesis: Compulsory |