# **Module Manual**

# Master of Science (M.Sc.) Civil Engineering

Cohort: Winter Term 2021 Updated: 31st May 2021

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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".

#### **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.

#### 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.

#### **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 four alternative specializations "Harbor Construction and Coast Protection", "Underground Engineering", "Structures" and "Water and Traffic", as well as the master thesis. The core qualification covers 24 CP, each specialization covers 66 CP and the master thesis covers 30 CP. The program covers 120 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.

## **Core qualification**

Addule M0523: Business & Management           Module Responsible         Prof. Matthias Meyer           Admission Requirements         None           Recommended Previous         None           Knowledge         After taking part successfully, students have reached the following learning results           Professional Competence         After taking part successfully, students have reached the following learning results           Professional Competence         Students are able to find their way around selected special areas of management within the scope of business management.           Students are able to apply 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 explain and give reasons for decision proposals on practical issues in areas of business management.         Students are able to explain and give reasons for decision proposals on practical issues in areas of business management.           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		
Admission Requirements       None         Recommended Previous Knowledge       None         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.         Skills       .         Skills       .         Students are able to apply basic methods in selected areas of business management.       .         Skills       .         Students are able to explain and give reasons for decision proposals on practical issues in areas of business management.         Students are able to explain and give reasons for decision proposals on practical issues in areas of business management.         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	Module M0523: Busin	ess & Management
Admission Requirements       None         Recommended Previous Knowledge       None         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.         Skills       .         Skills       .         Students are able to apply basic methods in selected areas of business management.       .         Skills       .         Students are able to explain and give reasons for decision proposals on practical issues in areas of business management.         Students are able to explain and give reasons for decision proposals on practical issues in areas of business management.         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	Modulo Posponsiblo	Dref Matthias Mover
Recommended Previous Knowledge       None         Educational Objectives       After taking part successfully, students have reached the following learning results         Professional Competence Knowledge <ul> <li>Students are able to find their way around selected special areas of management within the scope of business management.</li> <li>Students are able to explain basic theories, categories, and models in selected special areas of business management.</li> <li>Students are able to interrelate technical and management knowledge.</li> </ul> Skills <ul> <li>Students are able to apply basic methods in selected areas of business management.</li> <li>Students are able to explain and give reasons for decision proposals on practical issues in areas of business management.</li> <li>Students are able to communicate in small interdisciplinary groups and to jointly develop solutions for complex problems</li> <li>Students are capable of acquiring necessary knowledge independently by means of research and preparation of material.</li> </ul>		
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Educational Objective       After taking part successfully, students have reached the following learning results         Professional Competence       Knowledge         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.         • 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		None
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<ul> <li>Students are able to apply basic methods in selected areas of business management.</li> <li>Students are able to explain and give reasons for decision proposals on practical issues in areas of business management.</li> <li>Students are able to explain and give reasons for decision proposals on practical issues in areas of business management.</li> <li>Students are able to communicate in small interdisciplinary groups and to jointly develop solutions for complex problems</li> <li>Autonomy</li> <li>Students are capable of acquiring necessary knowledge independently by means of research and preparation of material.</li> <li>Workload in Hours</li> <li>Depends on choice of courses</li> </ul>		<ul> <li>Students are able to find their way around selected special areas of management within the scope of business management</li> <li>Students are able to explain basic theories, categories, and models in selected special areas of business management.</li> <li>Students are able to interrelate technical and management knowledge.</li> </ul>
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	Skills	<ul> <li>Students are able to apply basic methods in selected areas of business management.</li> </ul>
Students are able to communicate in small interdisciplinary groups and to jointly develop solutions for complex problems     Students are capable of acquiring necessary knowledge independently by means of research and preparation of material.     Workload in Hours Depends on choice of courses	Personal Competence	
Students are capable of acquiring necessary knowledge independently by means of research and preparation of material.     Workload in Hours Depends on choice of courses	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.
Credit points 6	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	Dagmar Richter
Admission Requirements	
<b>Recommended Previous</b>	None
Knowledge	
	After taking part successfully, students have reached the following learning results
Professional Competence Knowledge	The Nontechnical Academic Programms (NTA)
	imparts skills that, in view of the TUHH's training profile, professional engineering studies require but are not able to cover a Self-reliance, self-management, collaboration and professional and personnel management competences. The departm implements these training objectives in its <b>teaching architecture</b> , in its <b>teaching and learning arrangements</b> , in <b>teach</b> <b>areas</b> and by means of teaching offerings in which students can qualify by opting for <b>specific competences</b> and a <b>compete</b> <b>level</b> at the Bachelor's or Master's level. The teaching offerings are pooled in two different catalogues for nontech complementary courses.
	The Learning Architecture
	consists of a cross-disciplinarily study offering. The centrally designed teaching offering ensures that courses in the nontech academic programms follow the specific profiling of TUHH degree courses.
	The learning architecture demands and trains independent educational planning as regards the individual developmen competences. It also provides orientation knowledge in the form of "profiles".
	The subjects that can be studied in parallel throughout the student's entire study program - if need be, it can be studied in or two semesters. In view of the adaptation problems that individuals commonly face in their first semesters after making transition from school to university and in order to encourage individually planned semesters abroad, there is no obligation study these subjects in one or two specific semesters during the course of studies.
	Teaching and Learning Arrangements
	provide for students, separated into B.Sc. and M.Sc., to learn with and from each other across semesters. The challenge of de with interdisciplinarity and a variety of stages of learning in courses are part of the learning architecture and are deliber encouraged in specific courses.
	Fields of Teaching
	are based on research findings from the academic disciplines cultural studies, social studies, arts, historical stu communication studies, migration studies and sustainability research, and from engineering didactics. In addition, from the w semester 2014/15 students on all Bachelor's courses will have the opportunity to learn about business management and start in a goal-oriented way.
	The fields of teaching are augmented by soft skills offers and a foreign language offer. Here, the focus is on encouraging or oriented communication skills, e.g. the skills required by outgoing engineers in international and intercultural situations.
	The Competence Level
	of the courses offered in this area is different as regards the basic training objective in the Bachelor's and Master's fields. The differences are reflected in the practical examples used, in content topics that refer to different professional application cont and in the higher scientific and theoretical level of abstraction in the B.Sc.
	This is also reflected in the different quality of soft skills, which relate to the different team positions and different group leade functions of Bachelor's and Master's graduates in their future working life.
	Specialized Competence (Knowledge)
	Students can
	<ul> <li>explain specialized areas in context of the relevant non-technical disciplines,</li> <li>outline basic theories, categories, terminology, models, concepts or artistic techniques in the disciplines represented in learning area,</li> <li>different specialist disciplines relate to their own discipline and differentiate it as well as make connections,</li> <li>sketch the basic outlines of how scientific disciplines, paradigms, models, instruments, methods and forms of representation in the specialized sciences are subject to individual and socio-cultural interpretation and historicity,</li> <li>Can communicate in a foreign language in a manner appropriate to the subject.</li> </ul>
Skills	Professional Competence (Skills)
	In selected sub-areas students can
	<ul> <li>apply basic and specific methods of the said scientific disciplines,</li> <li>aquestion a specific technical phenomena, models, theories from the viewpoint of another, aforementioned specidiscipline,</li> <li>to handle simple and advanced questions in aforementioned scientific disciplines in a sucsessful manner,</li> <li>justify their decisions on forms of organization and application in practical questions in contexts that go beyond</li> </ul>

# Module Manual M.Sc. "Civil Engineering"

Courses

Personal Competence	
Social Competence	Personal Competences (Social Skills)
	<ul> <li>Students will be able</li> <li>to learn to collaborate in different manner,</li> <li>to present and analyze problems in the abovementioned fields in a partner or group situation in a manner appropriate to the addressees,</li> <li>to express themselves competently, in a culturally appropriate and gender-sensitive manner in the language of the country (as far as this study-focus would be chosen),</li> <li>to explain nontechnical items to auditorium with technical background knowledge.</li> </ul>
Autonomy	Personal Competences (Self-reliance)
	Students are able in selected areas
	<ul> <li>to reflect on their own profession and professionalism in the context of real-life fields of application</li> </ul>
	to organize themselves and their own learning processes
	<ul> <li>to reflect and decide questions in front of a broad education background</li> <li>to communicate a nontechnical item in a competent way in writen form or verbaly</li> </ul>
	<ul> <li>to organize themselves as an entrepreneurial subject country (as far as this study-focus would be chosen)</li> </ul>
Workload in Hours	Depends on choice of courses
Credit points	6

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

6				
Courses				
Title		Тур	Hrs/wk	СР
Finite Element Methods (L0291) Finite Element Methods (L0804)		Lecture Recitation Section (large)	2	3 3
Module Responsible	Prof. Otto von Estorff	Recitation Section (large)	2	5
Admission Requirements				
	Mechanics I (Statics, Mechanics of Materials) and Mech	anics II (Hydrostatics Kinematics Dyn	amics)	
	Mathematics I, II, III (in particular differential equations			
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
Professional Competence				
Knowledge	The students possess an in-depth knowledge regard overview of the theoretical and methodical basis of the		nt method and	are able to give
Skills	The students are capable to handle engineering prob system matrices, and solving the resulting system of e		nents, assemblin	g the correspondi
	Students can work in small groups on specific problem The students are able to independently solve challe			
	Problems can be identified and the results are critically	y scrutinized.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	6		
Credit points	6			
Course achievement	Compulsory Bonus Form Des	cription		
	No 20 % Midterm			
Examination	Written exam			
Examination duration and	120 min			
scale				
-	Civil Engineering: Core qualification: Compulsory			
Following Curricula	Energy Systems: Core qualification: Elective Compulso	•		
	Aircraft Systems Engineering: Specialisation Aircraft Sy			
	Aircraft Systems Engineering: Specialisation Air Transp			
	Aircraft Systems Engineering: Core qualification: Election			
	International Management and Engineering: Specialisa			
	International Management and Engineering: Specialisa	tion II. Product Development and Produ	iction: Elective Co	ompulsory
	Mechatronics: Core qualification: Compulsory			
	Biomedical Engineering: Specialisation Implants and E			
	Biomedical Engineering: Specialisation Management a			
	Biomedical Engineering: Specialisation Medical Techno	logy and Control Theory: Elective Com	oulsory	
	Biomedical Engineering: Specialisation Artificial Organ	•	Compulsory	
	Product Development, Materials and Production: Core	qualification: Compulsory		
	Technomathematics: Specialisation III. Engineering Sci	ence: Elective Compulsory		
	Theoretical Mechanical Engineering: Core qualification	Compulson		

Course L0291: Finite Element Methods		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Otto von Estorff	
Language	EN	
Cycle	WiSe	
Content	- General overview on modern engineering	
	- Displacement method	
	- Hybrid formulation	
	- Isoparametric elements	
	- Numerical integration	
	- Solving systems of equations (statics, dynamics)	
	- Eigenvalue problems	
	- Non-linear systems	
	- Applications	
	- Programming of elements (Matlab, hands-on sessions)	
	- Applications	
Literature	Bathe, KJ. (2000): Finite-Elemente-Methoden. Springer Verlag, Berlin	

Course L0804: Finite Elemen	Course L0804: Finite Element Methods	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Otto von Estorff	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title		Тур	Hrs/wk	СР
Safety, Reliability and Risk Assessr	ment (L1145)	Seminar	2	3
Environment and Sustainability (LC	)319)	Lecture	2	3
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements	None			
<b>Recommended Previous</b>	none			
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge	Students are able to describe single tec	hniques and to give an overview for the field	of safety and risk as	sessment as well
	environmental and sustainable engineeri	ng, in detail:		
	<ul> <li>basics in safety and reliability of te</li> </ul>	schnical facilities		
	<ul> <li>safety and reliability analysis meth</li> </ul>			
	<ul> <li>risk assessment</li> </ul>	1045		
	<ul> <li>Production and usage of bio-char</li> </ul>			
	<ul> <li>energy production and supply</li> </ul>			
	<ul> <li>sustainable product design</li> </ul>			
Skills	Students are able apply interdisciplinary system-oriented methods for risk assessment and sustainability reporting. They can evaluate the effort and costs for processes and select economically feasible treatment concepts.			
Personal Competence				
Social Competence				
Autonomy	<sup>7</sup> Students can gain knowledge of the sub	ject area from given sources and transform it	to new questions. Fu	rthermore, they o
	define targets for new application or rese	earch-oriented duties in for risk management a	nd sustainability conce	epts accordance v
	the potential social, economic and cultura	al impact.		
Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56		
Credit points				
Course achievement				
Examination	Written elaboration			
Examination duration and	Elaboration and presentation (45 minutes	s in groups)		
scale				
Assignment for the	Civil Engineering: Core qualification: Com	pulsory		
Following Curricula		C - Bioeconomic Process Engineering, Focu	s Management and	Controlling: Elect
	Compulsory		_ `	5
		ng: Specialisation II. Civil Engineering: Elective	Compulsory	
			· · · · · · · · · · · · · · · · · · ·	
	Product Development, Materials and Proc	luction: Specialisation Product Development: El	ective Compulsory	
		Juction: Specialisation Product Development: El Juction: Specialisation Production: Elective Com		
	Product Development, Materials and Proc		ipulsory	

Course L1145: Safety, Reliability and Risk Assessment			
Тур	Seminar		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Dr. Marco Ritzkowski		
Language	DE		
Cycle	WiSe		
Content	An introduction in safety and risk assessment is given and some typical problems of structural and environmental engineering are treated:    basics in safety and reliability of technical facilities  safety and reliability analysis methods  risk assessment  practical examples and excursions  discussions and presentations		
Literature	- Vorlesungsunterlagen - Schneider, J., Schlatter, H.P.: Sicherheit und Zuverlässigkeit im Bauwesen. www.risksafety.ch/files/ <b>sicherheit</b> _und_zuverlaessigkeit.pdf		

Course L0319: Environment	and Sustainability	
Тур	Lecture	
Hrs/wk	2	
СР	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 show	
	examples.	
	Production and Usage of Bio-char	
	Engergy production with algae	
	Environmental product design	
	Clean Development mechanism (CDM)	
	Democracy and Energy	
	New Concepts for a sustainable Energy Supply	
	Recycling of Wind Turbines	
	Alternative Mobility	
	Disposal of Nuclear Wastes	
	Waste2Energy	
	Offshore Wind energy	
Literature	Wird in der Veranstaltung bekannt gegeben.	

# **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		Lecture	2	2
Advanced Foundation Engineering	(L0498)	Recitation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe			
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 96, Study Time in L	ecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural E	ngineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnica	l Engineering: Compulsory		
	Civil Engineering: Specialisation Coastal Eng	neering: Compulsory		
	Civil Engineering: Specialisation Water and T	raffic: Elective Compulsory		
	International Management and Engineering:	Specialisation II. Civil Engineering: Elective Com	pulsory	

Course L0375: Numerical Me	ourse L0375: Numerical Methods in Geotechnics		
Тур	Lecture		
Hrs/wk	3		
СР			
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Dr. Hans Mathäus Stanford		
Language	DE		
Cycle	WiSe		
Content	Topics: • numerical simulations • numerical algorithms • finite element method • application of finite element method in geomechanics • constitutive models for soils • contact models for soil structure interaction • selected applications		
Literature	<ul> <li>Wriggers P. (2001): Nichtlineare Finite-Elemente-Methoden, Springer Verlag, Berlin</li> <li>Bathe Klaus-Jürgen (2002): Finite-Elemente-Methoden. Springer Verlag, Berlin</li> </ul>		

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

Course L0498: Advanced Foundation Engineering			
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	1		
Workload in Hours	ependent 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
Non destructive testing of material	s and parts (L2215)	Lecture	2	2
Non destructive testing of material		Project-/problem-based Learning	3	3
Non destructive testing of material	s and parts (L2216)	Recitation Section (large)	1	1
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge				
Educational Objectives	ter 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 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Written document about theory and praxis			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Elective Co	ompulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Elective Co	ompulsory		
	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Geotechnical Engineering: Elect	tive Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elective	Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elective	Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Com	pulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Com	pulsory		
	Materials Science: Specialisation Engineering Materials: Elective	Compulsory		

Course L2215: Non destructi	ve testing of materials and parts
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Robert Meißner, Prof. Marcus Rutner
Language	DE/EN
Cycle	WiSe
Content	This strongly interdisciplinary lecture and practical course is offered to Masterstudents who are interesed to learn about an
	important field across engineering and material science industries, i.e. nondestructive testing of materials and parts. Interdisciplinary approaches and thinking becomes more and more important since many problems extend into various disciplines, hence, can only be solved through interdisciplinary thinking and collaboration. Accordingly, this module combines the efforts of 4 different disciplines, i.e. mechanical engineering, civil engineering, materials science and computer science with a touch of electrical engineering. Nondestructive testing (NDT) is the process of inspecting, testing, and evaluating materials, parts, and assemblies to understand properties and defects without causing damage to the material or part. This scientific approach enables to make intrinsic material and component characteristics visible. Hence, the approach links detection approaches (e.g. linear and nonlinear acoustic methods, ultrasonic testing, Magnetic Particle Testing, thermo-chemical methods, etc.) with material physics and the mechanics of components, further, with evaluation, interpretation, big data management, transmission of data, and cybersecurity. The module embraces a lecture and a practical course. Contents of the lecture are NTD technologies and their theory behind, evaluation, transmission of data, while the students will apply the NDT technologies during the practical course in the experimental test halls and labs at TUHH. Lecture and practical course split into the major themes: A) Detection: Theory and Practice B) Evaluation of Data: Theory and Practice C) Data Acquisition and Transmission with Wireless, Batteryless Sensor Devices:Theory and Practice
Literature	

Course L2217: Non destructi	ourse L2217: Non destructive testing of materials and parts		
Тур	Project-/problem-based Learning		
Hrs/wk	3		
СР			
Workload in Hours	dependent Study Time 48, Study Time in Lecture 42		
Lecturer	of. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Robert Meißner, Prof. Marcus Rutner		
Language	E/EN		
Cycle	liSe		
Content	ee interlocking course		
Literature	See interlocking course		

Course L2216: Non destructi	ve testing of materials and parts
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Robert Meißner, Prof. Marcus Rutner
Language	DE/EN
Cycle	WiSe
Content	This strongly interdisciplinary lecture and practical course is offered to Masterstudents who are interesed to learn about an
	important field across engineering and material science industries, i.e. nondestructive testing of materials and parts. Interdisciplinary approaches and thinking becomes more and more important since many problems extend into various disciplines, hence, can only be solved through interdisciplinary thinking and collaboration. Accordingly, this module combines the efforts of 4 different disciplines, i.e. mechanical engineering, civil engineering, materials science and computer science with a touch of electrical engineering. Nondestructive testing (NDT) is the process of inspecting, testing, and evaluating materials, parts, and assemblies to understand properties and defects without causing damage to the material or part. This scientific approach enables to make intrinsic material and component characteristics visible. Hence, the approach links detection approaches (e.g. linear and nonlinear acoustic methods, ultrasonic testing, Magnetic Particle Testing, thermo-chemical methods, etc.) with material physics and the mechanics of components, further, with evaluation, interpretation, big data management, transmission of data, and cybersecurity. The module embraces a lecture and a practical course. Contents of the lecture are NTD technologies and their theory behind, evaluation, transmission of data, while the students will apply the NDT technologies during the practical course in the experimental test halls and labs at TUHH. Lecture and practical course split into the major themes: A) Detection: Theory and Practice B) Evaluation of Data: Theory and Practice C) Data Acquisition and Transmission with Wireless, Batteryless Sensor Devices:Theory and Practice
Literature	

Courses					
Title		Тур	Hrs/wk	СР	
Basics of Coastal Engineering (L08)		Lecture	3	4	
Basics of Coastal Engineering (L14		Project-/problem-based Learning	1	2	
Module Responsible					
Admission Requirements					
	Basics of hydraulic engineering, hydrology and hydrome	echanics			
Knowledge					
Educational Objectives	After taking part successfully, students have reached th	e following learning results			
Professional Competence					
Knowledge	The students are able to define and explain the basic co	ncepts of coastal engineering and port e	ngineering. T	hey are able to ap	
	the concepts to selected practical problems of coastal engineering. Students can define and determine the basics for design ar				
	dimensioning of coastal engineering constructions.				
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 gained knowledg	e in applied problems such as the desig	n of coastal p	protection structu	
	Additionaly, they will be able to work in team with engin	eers of other disciplines, for instance des	signing of coa	stal breakwaters.	
A	The students will be able to independently extend their				
Autonomy	The students will be able to independently extend their	knowledge and appryit to new 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	The duration of the examination is 2 hours. The exam	nination includes tasks with respect to	the general u	understanding of	
scale	lecture contents and calculations tasks.				
Assignment for the	Civil Engineering: Specialisation Structural Engineering:	Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering	ng: Compulsory			
-	Civil Engineering: Specialisation Coastal Engineering: Co	ompulsory			
	International Management and Engineering: Specialisati				

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

Course L1413: Basics of Coas	rse 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	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M0964: Unde	rground Constructions			
	-			
Courses				
Title		Тур	Hrs/wk	СР
Applied Tunnel Constructions (L240		Lecture	2	3
Introduction to tunnel construction		Lecture	1	2
Introduction to tunnel construction	(L1811)	Recitation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>	Modules from Bachelor studies Civil and en	vironmental engineering:		
Knowledge				
	Geotechnics I-II			
	Steel Structures I-II			
Educational Objectives	After taking part successfully, students hav	ve reached the following learning results		
Professional Competence				
Knowledge	Knowledge of different tunnel construction	types as well as special methods and technique	es of subsoil const	ruction. The studer
	get deeper knowledge of steel and ground engineering as well as constructions knowledge concerning quay walls.			
		e to design singular construction elements for	• • •	
	choose the right construction elements dep			
Skills	Basic knowledge of tunnel design as well as practical skills in structural tunnel analysis. 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			inea sheet phe hai
Personal Competence				
	Capacity for teamwork concerning project r	management and design of tunnels		
,		rk flow in the framework of a design exercise.		
		-		
	Independent Study Time 124, Study Time i	n Lecture 56		
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and	120 minutes			
scale				
Assignment for the	Civil Engineering: Specialisation Structural	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnic	cal Engineering: Compulsory		
	Civil Engineering: Specialisation Coastal En	gineering: Compulsory		
	Civil Engineering: Specialisation Water and	Traffic: Elective Compulsory		
	International Management and Engineering	9: Specialisation II. Civil Engineering: Elective Cor	npulsory	

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			
СР			
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Marius Milatz		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Definitions</li> <li>Historical development in tunneling</li> <li>Geology for tunneling</li> <li>Hard rock tunneling (construction composite and machines)</li> <li>Tunnelung in temporarly stable soil with conventional construction methods</li> <li>Tunneling in soft soils (form of supports, shield types, compressed air application)</li> <li>Pipe jacking</li> <li>Tunnel Lining, tunnel supporting structures</li> <li>Calculation approaches for supporting structures in shield-driven tunnels</li> <li>Surveying for tunneling</li> <li>Safety requirements</li> <li>Construction Contract</li> <li>Literature and sources</li> </ul>		
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	Marius Milatz	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title		Тур	Hrs/wk	СР
Sustainability Management (L0007)	)	Lecture	2	1
Hydro Power Use (L0013)		Lecture	1	1
Wind Turbine Plants (L0011)		Lecture	2	3
Wind Energy Use - Focus Offshore (		Lecture	1	1
Module Responsible				
	None			
Knowledge	Module: Technical Thermodynamics II,			
	Module: Fundamentals of Fluid Mechanic	CS		
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	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 at to describe fundamentally the use of water power to generate electricity. The students reproduce and explain the basic procedu 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	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 the 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-specificly and multidisciplinary within a seminar.			
Autonomy	Students can independently exploit sou	urces in the context of the emphasis of the	lecture material to clear	r the contents of
	lecture and to acquire the particular knowledge about the subject area.			
Werkland in Heure	Independent Study Time OF Study Time	in Lacture 94		
	Independent Study Time 96, Study Time	e în Lecture 64		
Credit points				
	None			
	Written exam			
	2.5 hours written exam + written elabor	ration (incl. presentation) in sustainability mar	nagement	
scale				
-	Civil Engineering: Specialisation Structu			
Following Curricula	Civil Engineering: Specialisation Geotec			
	Civil Engineering: Specialisation Coastal	• • • •		
	•••	Specialisation Energy Engineering: Elective C		
		ring: Specialisation II. Energy and Environmen		Compulsory
		ring: Specialisation II. Renewable Energy: Elec		
		oduction: Specialisation Product Development:		
		duction: Specialisation Production: Elective Co		
		oduction: Specialisation Materials: Elective Cor	mpulsory	
	Renewable Energies: Core qualification:			
		chnical Complementary Course: Elective Comp		
	• • •	ecialisation Energy Systems: Elective Compute	-	
	Water and Environmental Engineering: Specialisation Environmental	ironmental Process Engineering: Elective Com	ipui501 y	

Course L0007: Sustainability	Management		
Тур	Lecture		
Hrs/wk	2		
СР			
Workload in Hours	ndependent Study Time 2, Study Time in Lecture 28		
Lecturer	Dr. Anne Rödl		
Language	DE		
Cycle	SoSe		
Content	The lecture "Sustainability Management" gives an insight into the different aspects and dimensions of sustainability. First, essential terms and definitions, significant developments of the last years, and legal framework conditions are explained. The various aspects of sustainability are then presented and discussed in detail. The lecture mainly focuses on concepts for the implementation of the topic sustainability in companies: <ul> <li>What is "sustainability"?</li> <li>Why is this concept an important topic for companies?</li> <li>What opportunities and business risks are addressed or are associated with it?</li> </ul>		
	<ul> <li>How can the often mentioned three pillars of sustainability - economy, ecology, and social- be meaningfully integra corporate management despite their sometimes contradictory tendencies, and how a corresponding compromise found?</li> <li>What concepts or frameworks exist for the implementation of sustainability management in companies?</li> <li>Which sustainability labels exist for products or companies? What do they have in common, and where do they differ</li> </ul>		
	Furthermore, the lecture is intended to provide insights into the concrete implementation of sustainability aspects into business practice. External lecturers from companies will be invited to report on how sustainability is integrated into their daily processes. In the course of an independently carried out group work, the students will analyze and discuss the implementation of sustainability aspects based on short case studies. By studying and comparing best practice examples, the students will learn about corporate decisions' effects and implications. It should become clear which risks or opportunities are associated if sustainability aspects are taken into account in management decisions.		
Literature	Die folgenden Bücher bieten einen Überblick: Engelfried, J. (2011) Nachhaltiges Umweltmanagement. München: Oldenbourg Verlag. 2. Auflage Corsten H., Roth S. (Hrsg.) (2011) Nachhaltigkeit - Unternehmerisches Handeln in globaler Verantwortung. Wiesbaden: Gabler Verlag.		

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Digital Building (L1908)		Lecture	2	2
Lean Construction (L1910)		Lecture	2	2
System Dynamics (L1909)		Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>				
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 96, Study Time	e in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotec	hnical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Structu	ral Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water a	and Traffic Elective Compulson		

Course L1908: Digital Building		
Тур	cture	
Hrs/wk		
CP	2	
Workload in Hours	lependent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Katja Maaser	
Language	DE	
Cycle	SoSe	
Content		
Literature		

Course L1910: Lean Construction		
Тур	ure	
Hrs/wk		
CP	2	
Workload in Hours	pendent Study Time 32, Study Time in Lecture 28	
Lecturer	Theo Herzog	
Language	DE	
Cycle	SoSe	
Content		
Literature		

Course L1909: System Dynam	ourse L1909: System Dynamics		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Dr. Markus Salge		
Language	DE		
Cycle	SoSe		
Content			
Literature			

## 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	ıre	2	2
Technology of mineral Building Materials (L0256)			Proje	ct-/problem-based Learning	1	2
Transport Processes in Building Ma	aterials and Damage Processes (L0254) Lecture 1 1					1
Module Responsible	Prof. Frank Schmidt-Döhl					
Admission Requirements	None					
<b>Recommended Previous</b>	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, 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 manufacture this mortar. The students are able to manufacture post installed rebar connections. T able to recognize damages, to assess possible causes, to use the fundamentals of construction preservation and to sele and strengthening measures.					
						and to select rep
Personal Competence						
Social Competence						
	other students. In a critical discussion they defend and adjust their results. The students are able to manufacture their					ifacture their spec
	building material on the basis of this feedback.					
Autonomy	The students are able to respo	nsibly use the reso	ources of materials a	and lab equipment for thei	r project and	to investigate and
	get missing components.					
Workload in Hours	Independent Study Time 110, S	itudy Time in Lectu	ire 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	pendent 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	ourse L0256: Technology of mineral Building Materials				
Тур	ject-/problem-based Learning				
Hrs/wk					
СР					
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14				
Lecturer	f. Frank Schmidt-Döhl				
Language	DE				
Cycle	Se				
Content	Design and production of a special mineral building material				
Literature	ylor, 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	pendent Study Time 16, Study Time in Lecture 14				
Lecturer	Frank Schmidt-Döhl				
Language					
Cycle	SoSe				
Content	ansport Processes in Building Materials and Damage Processes				
Literature	Blaich, J.: Bauschäden, Analyse und Vermeidung				

Title		Hrs/wk	СР
and Field Work (L2754)	Project-/problem-based Learning		4
	Lecture	1	2
Prof. Nima Shokri			
None			
After taking part successfully, students hav	e reached the following learning results		
Independent Study Time 124, Study Time ir	n Lecture 56		
6			
None			
Written elaboration			
Report (about 5-10 pages) and Presentatior	(about 15 min)		
Civil Engineering: Specialisation Coastal Eng	gineering: Elective Compulsory		
Civil Engineering: Specialisation Water and	Traffic: Elective Compulsory		
Civil Engineering: Specialisation Coastal Eng	gineering: Elective Compulsory		
Civil Engineering: Specialisation Water and	Traffic: Elective Compulsory		
Environmental Engineering: Specialisation V	Vater: Elective Compulsory		
Environmental Engineering: Specialisation \	Vater: Elective Compulsory		
• • •			
• • •			
• • •			
• • •			
	753)         Prof. Nima Shokri         None         After taking part successfully, students have         Independent Study Time 124, Study Time in         6         None         Written elaboration         Report (about 5-10 pages) and Presentation         Civil Engineering: Specialisation Coastal Eng         Civil Engineering: Specialisation Coastal Eng         Civil Engineering: Specialisation Water and         Civil Engineering: Specialisation Water and         Environmental Engineering: Specialisation Water and         Environmental Engineering: Specialisation Water and         Mater and Environmental Engineering: Specialisation Water and Environmental Engineering: Specialisa	753)       Lecture         Prof. Nima Shokri         None         After taking part successfully, students have reached the following learning results         Independent Study Time 124, Study Time in Lecture 56         6         None	753)       Lecture       1         Prof. Nima Shokri

Course L2754: Water and En	Course L2754: Water and Environment: Application and Field Work				
Тур	ect-/problem-based Learning				
Hrs/wk					
СР	4				
Workload in Hours	pendent Study Time 78, Study Time in Lecture 42				
Lecturer	lexandru Tatomir, Hannes Nevermann				
Language	EN				
Cycle	SoSe				
Content					
Literature					

Course L2753: Water and En	ourse L2753: Water and Environment: Theory				
Тур	Lecture				
Hrs/wk	1				
СР	2				
Workload in Hours	ependent Study Time 46, Study Time in Lecture 14				
Lecturer	Nima Shokri				
Language	EN				
Cycle	SoSe				
Content					
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	Prof. Günter Rombach					
Admission Requirements	None					
<b>Recommended Previous</b>	Detailed knowledge on the design of conc	rete structures.				
Knowledge	Modules: Reinforced Concrete Structures I+II, Structural Analysis I+II, Mechanics I+II, Concrete Structures					
Educational Objectives	After taking part successfully, students have reached the following learning results					
Professional Competence						
Knowledge	The students know the main bridge type	s, their applications and the various loads. They o	an explain the b	asic design metho		
	They can explain the design of a prestressed bridge.					
Skills	The students are able to design reinforced	d or prestressed concrete bridges.				
Personal Competence						
•	The students can design in teamwork a re	al concrete bridge.				
	-	-				
Autonomy	The students are able to design a prestressed concrete bridge and discuss the problems and results with other students.					
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70				
Credit points						
Course achievement	None					
Examination	Written exam					
Examination duration and	180 minutes					
scale						
Assignment for the	Civil Engineering: Specialisation Structura	l Engineering: Compulsory				
-	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory					
	Civil Engineering: Specialisation Coastal E	ngineering: Elective Compulsory				
	International Management and Engineerin	g: Specialisation II. Civil Engineering: Elective Com	nulcon			

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

Course L0604: Design of Pre	ourse L0604: Design of Prestressed Structures and Concreet Bridges				
Тур	itation Section (large)				
Hrs/wk					
CP	2				
Workload in Hours	pendent Study Time 32, Study Time in Lecture 28				
Lecturer	Günter Rombach				
Language					
Cycle	SoSe				
Content	e interlocking course				
Literature	See interlocking course				

Module M0756: Soil M	lechanics and	-Dynamics					
Courses							
Title			Тур		Hrs/wk	СР	
Soil Mechanics - Selected Topics (L	0374)		Lecture		2	2	
Soil Dynamics (L0452) Experimental Researches in Gooter	baics (10706)		Lecture Practical	Courso	3 1	2 2	
Experimental Researches in Geoted			Flactical	Course	I	Z	
Module Responsible Admission Requirements	None						
		as III Machanica III C	atachnica I				
Recommended Previous	modules: Mathemati	CS I-III, Mechanics I-II, Ge					
Knowledge	courses: Soil laborate	ory course, (Applied stru	ctural dynamics)				
Educational Objectives	After taking part suc	cessfully, students have	reached the following learnin	g results			
Professional Competence							
Knowledge	After the successful	completion of the modul	e the students should be able	to:			
	• to derive and	to apply the basic equat	ion of a simple mass oscillato	r			
			n the soil under dynamic excit		atact the relevant par	amotors	
			ield tests to determine soil dy				
						e them,	
		hine foundations to dyn					
		locks to perform vibratio					
			ect on people and buildings,				
		ossibilities of isolation,					
		<ul> <li>to understand mechanisms that cause earthquakes and evaluate earthquake in term of their magnitude and intensity,</li> <li>to know methods to determine axial pile capacity, integrity and the dynamic bedding modulus,</li> </ul>					
	<ul> <li>to know the mechanisms that lead to a deformation accumulation due to cyclic loading and to estimate these deformatio mathematically,</li> </ul>						
	<ul> <li>to distinguish the area of application of the method of elastodynamics and plastodynamics,</li> </ul>						
	<ul> <li>to detect the upper term</li> </ul>	undrained shear strengt	h as a function of a number of	state variable	S,		
	<ul> <li>to capture the</li> </ul>	visous behaviour of co	hesive soils and to consider th	ne effects of cr	eep and rate-depende	ent shear strength	
	calculations,						
	• to consider th	e impact of the partly sa	turated of a seepage and she	ar strength.			
Skills							
Personal Competence							
Social Competence							
Autonomy	Independent Churk - T	ime Of Church Time ! !	actura 94				
Credit points		ime 96, Study Time in L	ecture 84				
Course achievement	Compulsory Bonus	Form	Description				
course achievement	Yes 15 %	Subject theoretical practical work					
Examination	Written exam						
Examination duration and	150 min						
scale	Civil Engineering: C-	ocialization Structure L	agingoring, Elective Computer	201			
Assignment for the Following Curricula			ngineering: Elective Compulso Il Engineering: Compulsory	лу			

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:	
	- continuum mechanis	
	- constitutive modelling	
	- time and rate dependend material behavior of soils	
	- cyclic loading	
	- undrained conditions	
Literature	Kolymbas D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. Springer Verlag	

Course L0452: Soil Dynamics		
Тур	Lecture	
Hrs/wk	3	
CP	2	
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42	
Lecturer	lexander Chmelnizkij	
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	<ul> <li>Das B.M.: Fundamentals of Soil Dynamics, Elsevier</li> <li>Empfehlungen des Arbeitskreises Baugrunddynamik. Hrsg. Deutsche Gesellschaft für Geotechnik (DGGT)</li> <li>Haupt W.: Bodendynamik. Vieweg und Teubner</li> <li>Meskouris K. und Hinzen KG.: Bauwerke und Erdbeben. Vieweg Verlag</li> <li>Studer J.A., Koller M.G. und Laue J.: Bodendynamik, Springer Verlag</li> </ul>	

Course L0706: Experimental	Researches in Geotechnics
Тур	Practical Course
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Marius Milatz
Language	DE
Cycle	SoSe
Content	<ul> <li>The students are supposed to:</li> <li>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.</li> <li>gain insight into current soil mechanical research.</li> <li>plan, coordinate, perform and evaluate soil mechanical tests in a team.</li> <li>discuss, reflect, review and present the obtained results in a group.</li> </ul> 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.
	<ul> <li>Kolymbas, D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. 2., korrigierte und ergänzte Auflage, Springer Verlag.</li> <li>Normen zu geotechnischen Versuchsgeräten und Versuchsverfahren: <ul> <li>DIN 18135:2012-04: Baugrund, Untersuchung von Bodenproben -</li> <li>Eindimensionaler Kompressionsversuch, Deutsches Institut für Normung, e. V.</li> </ul> </li> <li>DIN 18137-2:2011-04: Baugrund, Untersuchung von Bodenproben -</li> <li>Bestimmung der Scherfestigkeit - Teil 2: Triaxialversuch, Deutsches Institut für Normung, e. V.</li> </ul>

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Courses						
Title				Тур	Hrs/wk	СР
Boundary Element Methods (L0523				Lecture	2 2	3 3
Boundary Element Methods (L0524		-		Recitation Section (large)	Z	3
Module Responsible						
Admission Requirements						
	Mechanics I (Statics, Mechanics of Materials) and Mechanics II (Hydrostatics, Kinematics, Dynamics) Mathematics I, II, III (in particular differential equations)					
			•	ving learning regults		
Educational Objectives Professional Competence	Alter taking part succe	Jessiuny, students i	lave reached the follow	ving learning results		
Knowledge			ledge regarding the de	erivation of the boundary eler i.	ment method and	d are able to give
Skills			engineering problem ving the resulting syste	ns by formulating suitable t em of equations.	ooundary elemei	nts, assembling t
	Students can work in small groups on specific problems to arrive at joint solutions. The students are able to independently solve challenging computational problems and develop own boundary element routines Problems can be identified and the results are critically scrutinized.					
	Independent Study Tin	ime 124, Study Tim	e in Lecture 56			
Workload in Hours			c in Eccure 50			
Workload in Hours Credit points	6					
	Compulsory Bonus	Form Midterm	Description			
Credit points Course achievement	CompulsoryBonusNo20 %	<b>Form</b> Midterm				
Credit points Course achievement Examination	CompulsoryBonusNo20 %Written exam					
Credit points Course achievement Examination Examination duration and	CompulsoryBonusNo20 %Written exam					
Credit points Course achievement Examination Examination duration and scale	Compulsory         Bonus           No         20 %           Written exam           90 min	Midterm	Description	o Compulsory		
Credit points Course achievement Examination Examination duration and scale Assignment for the	Compulsory         Bonus           No         20 %           Written exam         90 min           Civil Engineering: Spece         100 min	Midterm ecialisation Structur	Description			
Credit points Course achievement Examination Examination duration and scale Assignment for the	Compulsory         Bonus           No         20 %           Written exam         90 min           Civil Engineering: Spec         Civil Engineering: Spec	Midterm ecialisation Structur ecialisation Geotech	Description ral Engineering: Elective nnical Engineering: Elec	ctive Compulsory		
Credit points Course achievement Examination Examination duration and scale Assignment for the	Compulsory         Bonus           No         20 %           Written exam         90 min           Civil Engineering: Spec         Civil Engineering: Spec           Civil Engineering: Spec         Civil Engineering: Spec	Midterm ecialisation Structur ecialisation Geotech ecialisation Coastal	Description ral Engineering: Elective nnical Engineering: Elec Engineering: Elective C	ctive Compulsory		
Credit points Course achievement Examination Examination duration and scale Assignment for the	Compulsory         Bonus           No         20 %           Written exam         90 min           Givil Engineering: Spect         Spect           Civil Engineering: Spect         Spect	Midterm ecialisation Structur ecialisation Geotech ecialisation Coastal e qualification: Elec	Description ral Engineering: Elective nnical Engineering: Elec Engineering: Elective C tive Compulsory	ctive Compulsory Compulsory	an Elective Corre	
Credit points Course achievement Examination Examination duration and scale Assignment for the	Compulsory         Bonus           No         20 %           Written exam         90 min           Givil Engineering: Spectrix         50 min           Civil Engineering: Spectrix         50 min           Civil Engineering: Spectrix         50 min           Bond         50 min	Midterm ecialisation Structur ecialisation Geotech ecialisation Coastal e qualification: Elec ing and Managemen	Description ral Engineering: Elective nnical Engineering: Elect Engineering: Elective C tive Compulsory nt: Specialisation Produ	ctive Compulsory Compulsory Ict Development and Productio	on: Elective Comp	pulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	Compulsory         Bonus           No         20 %           Written exam         90 min           Givil Engineering: Spect         Spect           Civil Engineering: Spect         Spect           Civil Engineering: Spect         Spect           Civil Engineering: Spect         Spect           Machine         Spect           Civil Engineering: Spect         Spect           Civil Engineering: Spect         Spect           Energy Systems: Core         Mechanical Engineering           Mechatronics: Speciali         Speciali	Midterm ecialisation Structur ecialisation Geotech ecialisation Coastal e qualification: Elec ing and Managemen ilisation System Des	Description ral Engineering: Elective nnical Engineering: Elect Engineering: Elective C tive Compulsory nt: Specialisation Produ sign: Elective Compulso	ctive Compulsory Compulsory Ict Development and Productic ory	on: Elective Comp	pulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	Compulsory         Bonus           No         20 %           Written exam         90 min           Givil Engineering: Spect         Spect           Civil Engineering: Spect         Spect           Civil Engineering: Spect         Spect           Civil Engineering: Spect         Spect           Mechanical Engineering         Spect           Mechanical Engineering         Speciali           Product Development,         Speciali	Midterm ecialisation Structur ecialisation Geotech ecialisation Coastal e qualification: Elec ing and Managemen ulisation System Des t, Materials and Pro	Description ral Engineering: Elective nnical Engineering: Elective Engineering: Elective C tive Compulsory nt: Specialisation Produ sign: Elective Compulso duction: Core qualificat	tive Compulsory Compulsory Ict Development and Productio Dry tion: Elective Compulsory	on: Elective Comp	pulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	Compulsory         Bonus           No         20 %           Written exam         90 min           Givil Engineering: Spectivil Engineering: Specti	Midterm ecialisation Structur ecialisation Geotech ecialisation Coastal e qualification: Elec ing and Managemen ulisation System Des t, Materials and Pro Specialisation III. E	Description ral Engineering: Elective anical Engineering: Elective Engineering: Elective C tive Compulsory nt: Specialisation Produ sign: Elective Compulso duction: Core qualificat ngineering Science: Elec	tive Compulsory Compulsory Ict Development and Productio Dry tion: Elective Compulsory	on: Elective Comp	pulsory

Course L0523: Boundary Element Methods				
Тур	Lecture			
Hrs/wk	2			
СР	3			
Workload in Hours	ndependent Study Time 62, Study Time in Lecture 28			
Lecturer	Prof. Otto von Estorff			
Language	EN			
Cycle	SoSe			
Content	- Boundary value problems			
	- Integral equations			
	- Fundamental Solutions			
	- Element formulations			
	- Numerical integration			
	- Solving systems of equations (statics, dynamics)			
	- Special BEM formulations			
	- Coupling of FEM and BEM			
	- Hands-on Sessions (programming of BE routines)			
	- Applications			
Literature	Gaul, L.; Fiedler, Ch. (1997): Methode der Randelemente in Statik und Dynamik. Vieweg, Braunschweig, Wiesbaden			
	Bathe, KJ. (2000): Finite-Elemente-Methoden. Springer Verlag, Berlin			

ourse L0524: Boundary Element Methods		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Otto von Estorff	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Гitle		Тур	Hrs/wk	СР
Groundwater Modeling using Modflow (L0543)		Lecture	1 2	1 2
Groundwater Modeling using Modflow (L0544) Modeling of Water Supply and Sewer Network (L0875)		Recitation Section (small) Project-/problem-based Learning	2	2
Module Responsible				-
-	None			
Recommended Previous				
Knowledge	e			
	<ul> <li>groundwater hydraulics and transport</li> </ul>	of substances		
	Pipe Systems			
	Knowledge on urban water infrastrug	ctures, in particular drinking water systemsand	urban drainag	e systems includi
	special structures		ansan arannag	
	<ul> <li>Hydraulics of drinking water supply sys</li> </ul>	stems and sewer systems		
	Basic knowledge on water managemen	nt		
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence	siter taking part successivily, stadents have			
•	The students are able to describe the modelli	ng of groundwater flow and transport as well as ur	ban water infra	astructures. They o
5		echnical and conceptual weak points within the sys		-
	are able to analyse interdependencies of hyd	raulic and toxic phenomena in soil and water.		
Skills	kills The students are able to construct and apply scientific groundwater models indipendently. They can work on d		n different scenario	
		s for existing problems by application of selected s	oftware produ	cts. The students a
	able to use different software solutions (e.g. I	EPANET, EPA-SWMM).		
Personal Competence				
Social Competence	Wird nicht vermittelt.			
Autonomy	Wird nicht vermittelt.			
Workload in House	Independent Study Time 110, Study Time in I	acture 70		
Credit points				
-	None			
Examination	Oral exam			
Examination duration and	20 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural En	gineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical	l Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engi	•		
	Civil Engineering: Specialisation Water and Tr	raffic: Elective Compulsory		
	Water and Environmental Engineering: Specia Water and Environmental Engineering: Specia			

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
1	

Course L0544: Groundwater	urse L0544: Groundwater Modeling using Modflow		
Тур	Recitation Section (small)		
Hrs/wk	2		
CP	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 and Sewer 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, Weitere Mitarbeiter	
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)		Lecture	2	2
Urban Infrastructures (L0874)		Project-/problem-based Learning	2	4
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
<b>Recommended Previous</b>	<ul> <li>Knowledge en Urban planning</li> </ul>			
Knowledge	Knowledge on Urban planning			
	<ul> <li>Knowledge on measures for climate protection</li> <li>General knowledge of scientific writing/working</li> </ul>			
	<ul> <li>General knowledge of scientific writing/working</li> </ul>			
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 environ	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 of life. They can, for example, derive and discuss measures for effective noise abatement.			
Ckilla				
SKIIIS	s Students are able to develop specific solutions for correcting existing or future environment-related problems of urb development. They can define a range of conceptual and technical solutions for environmental problems for different developme			
	baths. To solve specific urban environmental problems they can select technical innovations and integrate them into the urban			
	context.	an select technical innovations a	nu integrate t	
Personal Competence				
	The students can work together in international groups.			
boelar competence				
Autonomy	Students are able to organize their work flow to prepare them	selves for presentations and cont	ributions to th	e discussions. Th
	can acquire appropriate knowledge by making enquiries indepe	endently.		
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 Comput	sory		
	Joint European Master in Environmental Studies - Cities and Sus	stainability: Core qualification: Cor	npulsory	
	Logistics, Infrastructure and Mobility: Specialisation Infrastructu	ire and Mobility: Elective Compuls	ory	
	Water and Environmental Engineering: Specialisation Environm	ent: Elective Compulsory		

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:
	<ul> <li>Central vs. Decentral Wastewater Treatment.</li> <li>Compaction of Cities.</li> </ul>
	Compaction of cities.     Car Free Cities.
	Multifunctional Places in Cities.
	The Sustainability of Freight Transport in Cities.
Literature	Depends on chosen topic.

Courses					
		-	11	<u></u>	
<b>Title</b> Coastal- and Flood Protection (L08)	10)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 3	
Coastal- and Flood Protection (L080		Project-/problem-based Learning	1	1	
Coastal- and Flood Protection (L1415) Maintennance and Defence of Flood Protection Structures (L1411)		Lecture	2	2	
Module Responsible	Prof. Peter Fröhle				
Admission Requirements	None				
<b>Recommended Previous</b>	Coastal Engineering I				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the fol	llowing learning results			
<b>Professional Competence</b>					
Knowledge	The students have the capability to define and explain in detail the important aspects of erosion protection and flood protection				
	and are able to apply the aspects to practical coastal protection problems. They are able to design and dimension importa				
	coastal protection measures from the functional and from the constructional point of view.				
<i></i>	L		<i>c</i>		
Skills	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 tasks.				
Personal Competence					
Social Competence	The students are able to deploy their gained knowledge in applied problems such as the functional and constructive design				
	coastal and flood protection structures. Additionaly, they wil	Il be able to work in team with engine	eers of other d	lisciplines.	
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 130 min. The examina	ation includes tasks with respect to	the general ι	understanding of	
scale	lecture contents and calculations tasks.				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elec	ctive Compulsory			
	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory				
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: I	Liective compuisory			

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	DE
Cycle	SoSe
Content	Protection of sandy coasts
	Sediment transport
	Morphology     Tackaise lashting for the production of another production
	<ul> <li>Technical solution for the protection of sandy coasts</li> <li>Construction in direction of the coast</li> </ul>
	<ul> <li>Construction in allection of the coast</li> <li>Constructions perpendicular to the coast</li> </ul>
	<ul> <li>Other Concepst</li> </ul>
	Calculation approaches and numerical models
	Calculation approaches and numerical models
	Flood Protection
	Classification of constructions / measures
	• Dikes
	• Dunes
	Foreland - constructions
	Flood-Protection Walls
	Drainage of the hinterland
Literature	Vorlesungsumdruck
	Coastal Engineering Manual CEM
	1

Course L1415: Coastal- and	rse 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	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L1411: Maintennance	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	DE
Cycle	SoSe
Content	<ul> <li>Dike protection</li> <li>Maintennance of flood protection measures</li> </ul>
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			
<b>Recommended Previous</b>	Basics of coastal engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the followir	ng learning results		
Professional Competence				
Knowledge	edge 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.			
CI-III-				
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. Addition			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 examination	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: Electi	ive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Compulsor	у		
	Civil Engineering: Specialisation Water and Traffic: Elective Comp	oulsory		
	International Management and Engineering: Specialisation II. Civ	il Engineering: Elective Compuls	ory	
	Theoretical Mechanical Engineering: Technical Complementary C	Course: Elective Compulsory		

Course L0809: Harbour Engin	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	<ul> <li>Fundamentals of harbor engineering <ul> <li>Maritime transportation and waterways engineering</li> <li>Ships</li> </ul> </li> <li>Elements of harbors <ul> <li>Harbor approaches and water-side harbor areas</li> <li>Terminal design and handling of cargo</li> <li>Quay-walls and piers</li> <li>Equipment of harbors</li> <li>Sluices and other special constructions</li> </ul> </li> <li>Connection to inland transportation / inland waterway transportation</li> <li>Protection of harbors <ul> <li>Breakwaters and Jetties</li> <li>Wave protection of harbors</li> </ul> </li> <li>Fishery and other small harbors</li> </ul>
Literature	Brinkmann, B.: Seehäfen, Springer 2005

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Course L1414: Harbour Engi	irse 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       Workload in Hours     Ind       Lecturer     Fra       Language     DE       Cycle     So       Content     Image: Content	
Workload in Hours Ind Lecturer Fra Language DE Cycle So	nk Feindt
Lecturer Fra Language DE Cycle So	nk Feindt
Language DE Cycle So	
Cycle So	
-	õe
Content	
	<ul> <li>Planning and implementation of major projects</li> <li>Market analysis and traffic relations</li> <li>Planning process and plan</li> <li>Port planning in urban neighborhood</li> <li>Development of the logistics center "Port of Hamburg" in the metropolis</li> <li>Quays and waterfront structure</li> <li>Special planning Law Harbor - securing of a flexible use of the port</li> <li>Dimensioning of quays</li> <li>Flood protection structures</li> <li>Port of Hamburg - Infrastructure and development</li> <li>Preparation of areas</li> <li>Scour formation in front of shore structures</li> </ul>

Courses				
Title		<b>T</b>	Han fuels	CP
Hydraulic Models (L0813)		<b>Typ</b> Project-/problem-based Learning	Hrs/wk	1
Modelling of Waves (L0812)		Project-/problem-based Learning	1	1
Modelling of Flow in Rivers and Est	aries (L0810)	Lecture	3	4
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
<b>Recommended Previous</b>	Coastal Hydraulic Engineering I			
Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reached the f	ollowing 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 engineeri			
	Besides, they can describe the basic aspects of numerical modelling and actual numerical models for the simulation of fl waves.			
Chille	Students are able to apply hydrodynamic-numerical models to practical hydraulic engineering tasks.			
SKIIIS	students are able to apply hydrodynamic-humencar model	s to practical hydraulic engineering ta	565.	
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 tean			
	with others.			
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 3 hours. The examin	ation includes tasks with respect to	the general ι	inderstanding of t
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Ele	ective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering:	Elective Compulsory		

Course L0813: Hydraulic Mod	dels		
Тур	ject-/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	<ul> <li>Fundamentals of hydraulic models</li> <li>Model laws</li> <li>Pi theorem of Buckingham</li> <li>Practical examples of hydraulic models</li> <li>Strobl, Zunic: Wasserbau, Kap. 11 Hydraulische Modelle, Springer</li> </ul>		

Course L0812: Modelling of	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	<ul> <li>Waves, interactions with shallow water and constructions</li> <li>Wave theories</li> <li>Sea state and surges</li> <li>Development of waves</li> <li>Wave spectra</li> <li>Modelling of Waves / phase averaged and phase resolved models</li> <li>Application of a phase averaged model for wave prediction (SWAN)</li> <li>Application of phase resolved wave models (Mike)</li> </ul>		
Literature	Vorlesungsumdruck		

	low in Rivers and Estuaries		
	Lecture		
Hrs/wk			
СР	4		
	Independent Study Time 78, Study Time in Lecture 42		
	Dr. Edgar Nehlsen, Prof. Peter Fröhle		
Language			
Cycle	SoSe Introduction to numerical flow modelling		
	<ul> <li>Processes affecting tht flow</li> <li>Examples and applications of numerical models</li> <li>Procedure of numerical modelling</li> <li>Model concept</li> </ul> Basic equations of hydrodynamics <ul> <li>Saint-Venant equations</li> <li>Euler Equations</li> <li>Navier-Stokes equations</li> <li>Reynolds-averaged Navier-Stokes equations</li> </ul>		
	<ul> <li>Shallow water equations</li> <li>Solving schemes <ul> <li>Numerical discretization</li> <li>Solution algorithms</li> <li>Convergence</li> </ul> </li> </ul>		
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).		
	Wasserwirtschaft, Abwasser und Ablah (DWA-Regelwerk, 343-1). 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 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
Wastewater Systems - Collection, Treatment and Reuse (L0934)		Lecture	2	2
Wastewater Systems - Collection, 1	reatment and Reuse (L0943)	Recitation Section (large	) 1	1
Advanced Wastewater Treatment (		Lecture	2	2
Advanced Wastewater Treatment (				1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements				
Recommended Previous	Knowledge of wastewater management and	I the key processes involved in wastewater to	eatment.	
Knowledge				
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	Students are able to outline key areas of th	e full range of treatment systems in waste v	rater management, as	s well as their mutu
	dependence for sustainable water protectio	n. They can describe relevant economic, env	ironmental and social	factors.
Chille	Students are able to pre design and evolution	n the suciable westewater treatment proc	score and the score	of their application
SKIIIS	Students are able to pre-design and explain		sses and the scope of	or their application
	municipal and for some industrial treatment	plants.		
Personal Competence				
Social Competence	Social skills are not targeted in this module.			
Autonomy	Students are in a position to work on a si	ubject and to organize their work flow inde	pendently. They can	also present on the
	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 Structural E	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnic	al Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Eng	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and	Traffic: Compulsory		
	Bioprocess Engineering: Specialisation A - G	eneral Bioprocess Engineering: Elective Com	pulsory	
	Energy and Environmental Engineering: Spe	cialisation Environmental Engineering: Elect	ve Compulsory	
	Environmental Engineering: Specialisation V	Vater: Elective Compulsory		
	International Management and Engineering	Specialisation II. Process Engineering and B	otechnology: Elective	Compulsory
	International Management and Engineering	Specialisation II. Energy and Environmental	Engineering: Elective	Compulsory
	Process Engineering: Specialisation Environ	mental Process Engineering: Elective Compu	sory	
	Process Engineering: Specialisation Process	Engineering: Elective Compulsory		
	Water and Environmental Engineering: Spec	cialisation Water: Compulsory		
	Water and Environmental Engineering: Spec	cialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Spec			

Course L0934: Wastewater Systems - Collection, Treatment and Reuse			
Тур	Lecture		
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		
	<ul> <li>•Understanding the global situation with water and wastewater</li> <li>•Regional planning and decentralised systems</li> <li>•Overview on innovative approaches</li> <li>•In depth knowledge on advanced wastewater treatment options for different situations, for end-of-pipe and reuse</li> <li>•Mathematical Modelling of Nitrogen Removal</li> <li>•Exercises with calculations and design</li> </ul>		
Literature	Henze, Mogens: Wastewater Treatment: Biological and Chemical Processes, Springer 2002, 430 pages George Tchobanoglous, Franklin L. Burton, H. David Stensel: Wastewater Engineering: Treatment and Reuse, Metcalf & Eddy McGraw-Hill, 2004 - 1819 pages		

Course L0943: Wastewater Systems - Collection, Treatment and Reuse		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Ralf Otterpohl	
Language	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			
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 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	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 "Trans 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.
	<ul> <li>describe the main determinants of urban development.</li> </ul>
	<ul> <li>explain and compare different possibilities of how urban development can be influenced.</li> </ul>
	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
	<ul> <li>appraise such concepts in the context of competing requirements.</li> </ul>
	<ul> <li>design, justify and reflect their own solutions for concrete examples.</li> </ul>
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:
Autonomy	
	independently complete a written report including drawings following a broadly pre-defined process.
	assess the consequences of their proposed solutions.
	<ul> <li>independently acquire knowledge and apply this to new issues or problem areas.</li> </ul>
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 Water: 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:
	<ul> <li>legal framework,</li> <li>instruments and methods of planning,</li> <li>functional requirements,</li> <li>stakeholders and actors</li> <li>basic design requirements</li> <li>different planning levels and</li> <li>historical contexts.</li> </ul> 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 (2009) Stadtplanung: Eine illustrierte Einführung. Primus Verlag. Darmstadt. Frick, Dieter (2008) Theorie des Städtebaus: Zur baulich-räumlichen Organisation von Stadt. Wasmuth-Verlag. Tübingen
	They, Dieter (2000) meane des Stautebaus. Zur baunchmauminen organisation von Staut. Washluth-Verlag. Tubingen
	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	1	Hrs/wk	СР
Construction Logistics (L1163)	Lectu		1	2
Construction Logistics (L1164)		tation Section (small)	1	2
Project Development and Managen			1	1
Project Development and Managen		sct-/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				
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 con	nstruction 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 systems	S		
CL ///-				
Skills	Students can			
	<ul> <li>carry out project life cycle assessments</li> </ul>			
	apply methods and instruments of construction logistics			
	apply methods and instruments of project development and ma	anagement		
	<ul> <li>apply methods and instruments of conflict management</li> </ul>			
	design supply and waste removal concepts for a construction p	project		
Personal Competence				
Social Competence	Students can			
	<ul> <li>hold presentations in and for groups</li> </ul>			
	<ul> <li>apply methods of conflict solving skills in group work and cases</li> </ul>	studies		
Autonomy	Students can			
	solve problems by holistic, systemic and flow oriented thinking			
	<ul> <li>improve their creativity, negotiation skills, conflict and crises</li> </ul>		methods of	moderation in ca
	studies			
	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 Geotechnical Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Elective Comput			
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsor	ry		
	International Management and Engineering: Specialisation II. Civil Eng	jineering: Elective Compulso	ory	
	International Management and Engineering: Specialisation II. Logistics			
	Logistics, Infrastructure and Mobility: Specialisation Production and Lo	gistics: Elective Compulsory	/	
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and	Mobility: Elective Compuls	orv	

Course L1163: Construction I	Logistics		
Тур	Lecture		
Hrs/wk	1		
CP	2		
Workload in Hours	ndependent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Heike Flämig		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>The lecture gives deeper insight how important logistics are as a competetive factor for construction projects and which issues are to be adressed.</li> <li>The following toppics are covered: <ul> <li>competetive factor logistics</li> <li>the concept of systems, planning and coordination of logistics</li> <li>material, equipment and reverse logistics</li> <li>IT in construction logistics</li> <li>elements of the planning model of construction logistics and their connections</li> <li>flow oriented logistics systems for construction projects</li> <li>logistics concepts for ready to use construction projects (especially procurement and waste removel logistics)</li> <li>best practice examples (construction logistics Potsdamer Platz, recent case study of the region)</li> </ul> </li> </ul>		
Literature	Contents of the lecture are deepened in special exercises. 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)		

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	

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		
	<ul> <li>Advantages and disadvantages of different ways of project handling</li> </ul>		
	<ul> <li>organization, information, coordination and documentation</li> </ul>		
	cost and fincance management in projects		
	<ul> <li>time- and capacity management in projects</li> </ul>		
	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	se 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. Uwe Starossek			
Admission Requirements	None			
<b>Recommended Previous</b>	Knowledge of linear structural analysis of	of statically determinate and indeterminate struct	ures; Mechanics	I/II, Mathematics
Knowledge	Differential equations I			
	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge	After successful completion of this modu	lle, the student can explain the basic aspects of o	dynamic effects o	n structures and t
	respective methods.			
Skills	After successful completion of this mod	dule, the students will be able to predict the re	sponse of materi	al and structures
	dynamics loading using the appropriate co	omputational approacnes and methods.		
Personal Competence				
Social Competence	Students can			
	<ul> <li>participate in subject-specific and in</li> </ul>	nterdisciplinary discussions,		
	defend their own work results in fro	ont of others		
	<ul> <li>promote the scientific development</li> </ul>	t of colleagues		
	Furthermore, they can give and acc	cept professional constructive criticism		
Autonomy		ne subject area from given and other sources and a		oblems. Furthermoi
	they are able to structure the solution pro	cess for problems in the area of Structural Analysis	5.	
Workload in Hours	Independent Study Time 96, Study Time i	n Lecture 84		
Credit points	6			
Course achievement				
	Written exam			
Examination duration and	120 11111			
scale				
-	Civil Engineering: Specialisation Structura			
Following Curricula	Civil Engineering: Specialisation Geotechn			
	Civil Engineering: Specialisation Coastal E	ngineering: Elective Compulsory		
	Chill Frankranskan, Carl Heilter Mart	d Tarffin, Elective Community		
	Civil Engineering: Specialisation Water an	d Traffic: Elective Compulsory ng: Specialisation II. Civil Engineering: Elective Com	nulcon	

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. Uwe Starossek
Language	DE
Cycle	SoSe
Content	<ul> <li>Single-degree-of-freedom systems: undamped and damped vibration, free vibration, forced vibrations due to harmonic, periodical or arbitrary loading, natural frequency, damping</li> <li>vibration isolation</li> <li>solution in the frequency-domain (Fourier transformation), solution in the time-domain</li> <li>multi-degree-of-freedom systems: continuous or discrete systems, modelling with finite elements, generalisation</li> <li>modal analysis</li> <li>power iteration according to v.Mises</li> <li>earthquake loading: seismological basics, response spectrum method</li> <li>wind-induced vibrations: engineering meteorology, aerodynamic, classification of excitation mechanisms</li> </ul>
Literature	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	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Uwe Starossek	
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	<ul> <li>basics of fatigue stress and fatigue resistance and determination of fatigue strength,</li> </ul>
	<ul> <li>determination and use of S-N-curves and classification of notch effects,</li> </ul>
	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,
	<ul> <li>basics of construction and design regarding the problem of material fatigue,</li> </ul>
	basics of linear elastic fracture mechanics under static and dynamic load,
	<ul> <li>determination of lifetime of steel construction based on linear elastic fracture mechanics in different examples.</li> </ul>
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
	<ul> <li>DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsreg</li> <li>Bemessungsregeln f         ür den Hochbau; 1993</li> </ul>
	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 200

Course L0565: Fracture mec	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
Steel Construction Project (L1206)		Project Seminar	4	6
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
<b>Recommended Previous</b>	Steel and Composite Structures			
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge	Students are able to prepare a part of the	e whole project and explain it to the others.		
Skills	Students can produce sketches and cal	culations of their part of the project. They ar	e able to adjust their	r work in reaction
	changing conditions resulting from other	participants of the project.		
Personal Competence				
Social Competence	Students can present their results to othe	er members of the group.		
	They have the ability to work for a broad	agreement with respect to intergroup depende	ncies.	
	They can distribute and process tasks inc	lependently.		
Autonomy	Students can handle their part of the pro	ject on their own resposibility-		
Workload in Hours	Independent Study Time 124, Study Time	e 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 Geotech	nical Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal	Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Structure	al Engineering: Compulson		

Course L1206: Steel Constru	urse 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)		Recitation Section (large)	2	2
Steel Structures in Foundation and	Hydraulic Engineering (L1146)	Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>	complete modules: Geotechnics I-III, Mathema	tics I-III		
Knowledge				
	courses: Soil laboratory course			
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Le	ecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnical	Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Structural Eng	ineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engin	eering: Compulsory		
	Theoretical Mechanical Engineering: Specialisa	ation Maritime Technology: Elective Compulsory	r	
	Theoretical Mechanical Engineering: Technical	Complementary Course: Elective Compulsory		
	Water and Environmental Engineering: Special	isation Cities: Elective Compulsory		
	Water and Environmental Engineering: Special	isation Environment: Elective Compulsory		
	Water and Environmental Engineering: Special	isation Water: 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	<ul> <li>Geotechnical investigation an description of the seabed</li> <li>Foundations of Offshore-Constructions</li> <li>cCliff erosion</li> <li>Sea dikes</li> <li>Port structures</li> <li>Flood protection structures</li> </ul>		
Literature	<ul> <li>EAK (2002): Empfehlungen für Küstenschutzbauwerke</li> <li>EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke</li> <li>Poulos H.G. (1988): Marine Geotechnics. Unwin Hyman, London</li> <li>Wagner P. (1990): Meerestechnik: Eine Einführung für Bauingenieure. Ernst &amp; Sohn, Berlin</li> </ul>		

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

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

Courses				
<b>Fitle</b>		Тур	Hrs/wk	СР
Port Logistics (L0686)		Lecture	2	3
Port Logistics (L1473)		Recitation Section (small)	2	3
Module Responsible	Prof. Carlos Jahn			
Admission Requirements	None			
<b>Recommended Previous</b>	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
Professional Competence				
Knowledge	Th			
	After completing the module, students can			
	<ul> <li>reflect on the development of seaports (in term relevant operator models) and place them in the</li> <li>explain and evaluate different types of se technologies, logistic functional areas);</li> <li>analyze common planning tasks (e.g. berth plasuitable approaches (in terms of methods and terms of methods and terms in a problem-oriented manner.</li> </ul>	eir historical context; aport terminals and their specific c anning, stowage planning, yard plannin pols) to solve these planning tasks;	haracteristics (in a seaport te	cargo, transhipme rminals and develo
Skills	<ul> <li>After completing the module, students will be able to</li> <li>recognize functional areas in ports and seaport terminals;</li> <li>define and evaluate suitable operating systems for container terminals;</li> <li>perform static calculations with regard to given boundary conditions, e.g. required capacity (parking spaces, equipm requirements, quay wall length, port access) on selected terminal types;</li> <li>reliably estimate which boundary conditions influence common logistics indicators in the static planning of selected terminat types and to what extent.</li> </ul>			
Personal Competence Social Competence	After completing the module, students can • transfer the acquired knowledge to further ques • discuss and successfully organize extensive tas			
Autonomy	<ul> <li>in small groups, document work results in writin</li> <li>After completing the module, the students are able to.</li> <li>research and select specialist literature, includindependently;</li> <li>submit own parts in an extensive written elabot time frame.</li> </ul>	 ing standards, guidelines and journal	papers, and to c	levelop the conten
Workload in Hours	Independent Study Time 124, Study Time in Lecture 5	6		
Credit points	6			
Course achievement		cription		
	No 15 % Written elaboration			
Examination	Written exam			
Examination duration and	120 minutes			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: I			
Following Curricula	International Management and Engineering: Specialisa			
	Logistics, Infrastructure and Mobility: Specialisation Pro	•	-	
	Logistics, Infrastructure and Mobility: Specialisation Inf		oulsory	
	Renewable Energies: Specialisation Wind Energy Syste			
	Naval Architecture and Ocean Engineering: Core qualit			
	Theoretical Mechanical Engineering: Specialisation Ma	ritime Technology, Elective Computerer		

Course L0686: Port Logistics				
Тур	Lecture			
Hrs/wk	2			
CP	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Lecturer	f. Carlos Jahn			
Language	DE			
Cycle	SoSe			
Content	Port Logistics deals with the planning, control, execution and monitoring of material flows and the associated information flow 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 numer requirements in terms of economy, speed, safety and the environment. Against this background, the lecture Port Logistics de with the planning, control, execution and monitoring of material flows and the associated information flows in the port system a its interfaces to numerous actors inside and outside the port area. The aim of the lecture Port Logistics is to convey understanding of structures and processes in ports. The focus will be on different types of terminals, their characteristical layou 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 top 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			
Literature	<ul> <li>Alderton, Patrick (2013). Port Management and Operations.</li> <li>Biebig, Peter and Althof, Wolfgang and Wagener, Norbert (2017). Seeverkehrswirtschaft: Kompendium.</li> <li>Brinkmann, Birgitt. Seehäfen: Planung und Entwurf. Berlin Heidelberg: Springer-Verlag, 2005.</li> <li>Büter, Clemens (2013). Außenhandel: Grundlagen internationaler Handelsbeziehungen.</li> <li>Gleissner, Harald and Femerling, J. Christian (2012). Logistik: Grundlagen, Übungen, Fallbeispiele.</li> <li>Jahn, Carlos; Saxe, Sebastian (Hg.). Digitalization of Seaports - Visions of the Future, Stuttgart: Fraunhofer Verlag, 2017.</li> <li>Kummer, Sebastian (2019). Einführung in die Verkehrswirtschaft</li> <li>Lun, Y.H.V. and Lai, KH. and Cheng, T.C.E. (2010). Shipping and Logistics Management.</li> <li>Woitschützke, Claus-Peter (2013). Verkehrsgeografie.</li> </ul>			

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	<ul> <li>Alderton, Patrick (2013). Port Management and Operations.</li> <li>Biebig, Peter and Althof, Wolfgang and Wagener, Norbert (2017). Seeverkehrswirtschaft: Kompendium.</li> <li>Brinkmann, Birgitt. Seehäfen: Planung und Entwurf. (2005) Berlin Heidelberg: Springer-Verlag.</li> <li>Büter, Clemens (2013). Außenhandel: Grundlagen internationaler Handelsbeziehungen.</li> <li>Gleissner, Harald and Femerling, J. Christian (2012). Logistik: Grundlagen, Übungen, Fallbeispiele.</li> <li>Jahn, Carlos; Saxe, Sebastian (Hg.) (2017) Digitalization of Seaports - Visions of the Future, Stuttgart: Fraunhofer Verlag.</li> <li>Kummer, Sebastian (2019). Einführung in die Verkehrswirtschaft</li> <li>Lun, Y.H.V. and Lai, KH. and Cheng, T.C.E. (2010). Shipping and Logistics Management.</li> <li>Woitschützke, Claus-Peter (2013). Verkehrsgeografie.</li> </ul>

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Courses	
Title	Typ Hrs/wk CP
Maritime Transport (L0063) Maritime Transport (L0064)	Lecture 2 3 Recitation Section (small) 2 3
Module Responsible	
Admission Requirements	None
Recommended Previous Knowledge	
	After taking part successfully, students have reached the following learning results
Professional Competence	
•	The students are able to
	<ul> <li>present the actors involved in the maritime transport chain with regard to their typical tasks;</li> <li>name common cargo types in shipping and classify cargo to the corresponding categories;</li> <li>explain operating forms in maritime shipping, transport options and management in transport networks;</li> <li>weigh the advantages and disadvantages of the various modes of hinterland transport and apply them in practice;</li> <li>present relevant factors for the location planning of ports and seaport terminals and discuss them in a problem-orie way;</li> <li>estimate the potential of digitisation in maritime shipping.</li> </ul>
Skills	<ul> <li>The students are able to</li> <li>determine the mode of transport, actors and functions of the actors in the maritime supply chain;</li> <li>identify possible cost drivers in a transport chain and recommend appropriate proposals for cost reduction;</li> <li>record, map and systematically analyse material and information flows of a maritime logistics chain, identify poss problems and recommend solutions;</li> <li>perform risk assessments of human disruptions to the supply chain;</li> <li>analyse accidents in the field of maritime logistics and evaluating their relevance in everyday life;</li> </ul>
Personal Competence Social Competence	<ul> <li>deal with current research topics in the field of maritime logistics in a differentiated way;</li> <li>apply different process modelling methods in a hitherto unknown field of activity and to work out the respective advanta</li> </ul>
	<ul> <li>discuss and organise extensive work packages in groups;</li> </ul>
Autonomy	<ul> <li>document and present the elaborated results.</li> <li>The students are capable to</li> <li>research and select technical literature, including standards and guidelines;</li> <li>submit own shares in an extensive written elaboration in small groups in due time.</li> </ul>
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	Compulsory         Bonus         Form         Description           No         15 %         Subject         theoretical         andTeilnahme an einem Planspiel und anschließende schriftliche Ausarbeitung practical work
Examination	Written exam
Examination duration and	120 minutes
scale	
Assignment for the Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Logistics: Elective Compulsory Logistics, Infrastructure and Mobility: Specialisation Production and Logistics: Elective Compulsory
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective Compulsory
	Renewable Energies: Specialisation Wind Energy Systems: Elective Compulsory
	Theoretical Mechanical Engineering: Specialisation Maritime Technology: Elective Compulsory
	Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory

Course L0063: Maritime Tran	isport	
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Carlos Jahn	
Language	DE	
Cycle	SoSe	
Content	The general tasks of maritime logistics include the planning, design, implementation and control of material and information flor in the logistics chain ship - port - hinterland. This includes technology assessment, selection, dimensioning and implementation well as the operation of technologies. The aim of the course is to provide students with knowledge of maritime transport and the actors involved in the maritim transport chain. Typical problem areas and tasks will be dealt with, taking into account the economic development. Thus, classic 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 human disturbances on the supply chain will be developed. In addition, students learn to estimate the potential of digitisation maritime shipping, especially with regard to the monitoring of ships. Further content of the lecture is the different modes transport in the hinterland, which students can evaluate after completion of the course regarding their advantages and disadvantages.	
Literature	<ul> <li>Brinkmann, Birgitt. Seehäfen: Planung und Entwurf. Berlin Heidelberg: Springer-Verlag, 2005.</li> <li>Schönknecht, Axel. Maritime Containerlogistik: Leistungsvergleich von Containerschiffen in intermodalen Transportketten. Berlin Heidelberg: Springer-Verlag, 2009.</li> <li>Stopford, Martin. Maritime Economics Routledge, 2009</li> </ul>	

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	<ul> <li>Stopford, Martin. Maritime Economics Routledge, 2009</li> <li>Brinkmann, Birgitt. Seehäfen: Planung und Entwurf. Berlin Heidelberg: Springer-Verlag, 2005.</li> <li>Schönknecht, Axel. Maritime Containerlogistik: Leistungsvergleich von Containerschiffen in intermodalen Transportketten. Berlin Heidelberg: Springer-Verlag, 2009.</li> </ul>

Courses				
Title		Tun	Hrs/wk	СР
Smart Monitoring (L2762)		<b>Typ</b> Integrated Lecture	2	2
Smart Monitoring (L2763)		Recitation Section (small)	2	4
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
<b>Recommended Previous</b>	Basic knowledge or interest in object-oriented modeling, programming, and sensor technologies are helpful. Interest in mode			
Knowledge	research and teaching areas, such as Internet of Things, I skills of scientific working, are required. Basic knowledge in			s the will to deep
Educational Objectives	After taking part successfully, students have reached the fo	llowing learning results		
<b>Professional Competence</b>				
	The students will become familiar with the principles and decentralized smart systems to be applied for continuo environment. In addition, the students will learn to design analysis techniques, modern software design concepts, and also part of this module. In small groups, the students "intelligent" sensors to be implemented by the students techniques. The smart monitoring systems will be mounted on scaled lab structures for validation purposes. The outcor module will "automatically" participate with their smart r written papers and oral examinations form the final grades.	us (remote) monitoring of syste and to implement intelligent sense l embedded computing methodolo s will design smart monitoring s s. Specific focus will be put on d on real-world (built or natural) sy ome of every group will be docum monitoring system in the annual	ms in the built or systems using gies. Besides lect ystems that inte the application ystems, such as ented in a paper "Smart Monitorir	and in the natu state-of-the-art da tures, project worl egrate a number of machine learn bridges or slopes, . All students of t ng" competition.
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement				
	Written elaboration			
	10 pages of work with 15-minute oral presentation			
scale				
-	Civil Engineering: Specialisation Water and Traffic: Elective			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering:			
	Civil Engineering: Specialisation Coastal Engineering: Electi Civil Engineering: Specialisation Structural Engineering: Ele-			
	Civil Engineering: Specialisation Structural Engineering: Election			
	Civil Engineering: Specialisation Coastal Engineering: Electric Civil Engineering: Specialisation Geotechnical Engineering:			
	Civil Engineering: Specialisation Structural Engineering: Ele			
	Civil Engineering: Specialisation Water and Traffic: Elective			
	Environmental Engineering: Specialisation Waste and Energy			
	Environmental Engineering: Specialisation Biotechnology: E			
	Environmental Engineering: Specialisation Water: Elective C	Compulsory		
	Environmental Engineering: Specialisation Waste and Energy	y: Elective Compulsory		
	Environmental Engineering: Specialisation Biotechnology: E	lective Compulsory		
	Environmental Engineering: Specialisation Water: Elective C	Compulsory		
	Water and Environmental Engineering: Specialisation Cities	: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Cities	: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Enviro	onment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Enviro	onment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Water	r: Elective Compulsory		
	5	. Elective compaisory		

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	WiSe/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	

Course 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	WiSe/SoSe
Content	The contents of the exercises are based on the lecture contents. In addition to the exercises, project work will be conducted, 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.
Literature	

<u> </u>				
Courses				
Title		Тур	Hrs/wk	СР
Water Protection and Wastewater I Water Protection and Wastewater I	-	Lecture Project Seminar	3	3 3
Module Responsible	5	Hoject Seminar	5	5
Admission Requirements				
Recommended Previous	None			
Knowledge	<ul> <li>Basic knowledge in water managem</li> </ul>	ent;		
j-	<ul> <li>Good knowledge in urban drainage;</li> </ul>			
	<ul> <li>Good knowledge of wastewater treat</li> </ul>			
	<ul> <li>Good knowledge of pollutants (e.g. 0</li> </ul>	COD, BOD, TS, N, P) and their properties;		
Educational Objectives	After taking part successfully, students hav	ve reached the following learning results		
<b>Professional Competence</b>				
Knowledge	The students can describe the basic princip	oles of the regulatory framework related to th	e international and Eu	ropean water sect
	They can explain limnological processes,	substance cycles and water morphology in	detail. They are able	e to assess comp
	problems related to water protection, suc	h as ecosystem service and wastewater tre	atment with a special	focus on innovat
	solutions, remediation measures as well as	conceptual approaches.		
Skills	Students can accurately assess current pro	oblems and situations in a country-specific o	r local context. They c	an suggest concr
	actions to contribute to the planning of	tomorrow's urban water cycle. Furthermore	, they can suggest ap	opropriate technic
	administrative and legislative solutions to s	solve these problems.		
Demonal Commetence				
Personal Competence	The shudents are used, to rether is intermed			
Social Competence	The students can work together in internat	ional groups.		
Autonomy	Students are able to organize their work f	ow to prepare presentations and discussions	5. They can acquire ap	propriate knowled
	by making enquiries independently.			
W. 11 11				
Credit points	Independent Study Time 96, Study Time in	Lecture 84		
Course achievement				
Examination	Presentation			
Examination duration and	Term paper plus presentation			
scale				
-	Civil Engineering: Specialisation Structural	• • • • •		
Following Curricula	Civil Engineering: Specialisation Geotechnic	• • • •		
	Civil Engineering: Specialisation Coastal En Civil Engineering: Specialisation Water and			
	Environmental Engineering: Specialisation			
	5 5 1	g: Specialisation II. Civil Engineering: Elective	Compulsory	
		Judies - Cities and Sustainability: Specialisation		oulsorv
	Water and Environmental Engineering: Spe			
	Water and Environmental Engineering: Spe			
	Water and Environmental Engineering: Spe			

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

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	l Condition and Damages (L0260)	Lecture	3	4		
Examination of Materials, Structura	l Condition and Damages (L0261)	Recitation Section (small)	1	2		
Module Responsible	Prof. Frank Schmidt-Döhl					
Admission Requirements	None					
<b>Recommended Previous</b>	Basic knowledge about building materials or	material science, for example by the mod	lule Building Ma	aterials and Build		
Knowledge	Chemistry.					
Educational Objectives	After taking part successfully, students have re	ached the following learning results				
<b>Professional Competence</b>						
Knowledge	The students are able to describe the rules for	trading, use and marking of construction pro	oducts in Germai	ny. They know wh		
	methods for the testing of building material pro	perties are usable and know the limitations a	nd characterics c	of the most import		
	testing methods.					
Skille	The students are able to responsibly discover t	as rules for trading and using of huilding produ	icts in Cormony			
SKIIIS	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 are the examination of the structural conditions of huildings. They are able to conclude from sumptions to the example of damages. They are able to conclude from sumptions to the examination of damages.					
the examination of the structural conditions of buildings. They are able to conclude from symptons to the cause of are able to describe an examination in form of a test report or expert opinion.				ise of damages. If		
Personal Competence						
Social Competence	The students can describe the different roles of	of manufacturers as well as testing, supervise	ry and certificat	ion bodies within		
	framework of material testing. They can descril	be the different roles of the participants in lega	l proceedings.			
Autonomy	The students are able to make the timing and t	he operation steps to learn the specialist know	ledge of a very e	extensive field.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56					
Credit points	6					
Course achievement	None					
Examination	Written exam					
Examination duration and	120 min					
scale						
Assignment for the	Civil Engineering: Specialisation Structural Engi	neering: Elective Compulsory				
Following Curricula	Civil Engineering: Specialisation Geotechnical E	ngineering: Elective Compulsory				
	Civil Engineering: Specialisation Coastal Engine	ering: Elective Compulsory				
	Civil Engineering: Specialisation Water and Trat	fic: Elective Compulsory				
	International Management and Engineering: Sp	ecialisation II. Civil Engineering: Elective Comp	oulsory			
	Materials Science: Specialisation Engineering M	aterials: Elective Compulsory				

## Course L0260: Examination of Materials, Structural Condition and Damages Typ Lecture Lecture 3 OCP 4 Workload in Hours Independent Study Time 78, Study Time in Lecture 42 Lecturer Prof. Frank Schmidt-Döhl Language DE 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	
CP	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	

Module M1350: Excav	· · · · · · · · · · · · · · · · · · ·			
Courses				
Title		Тур	Hrs/wk	СР
Subsoil and Underground Engineer	ng Law (L0395)	Lecture	2	2
Service Contract and Procurement	Law (L1906)	Lecture	2	2
Project Geotechnics (L0708)		Project-/problem-based Learning	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	30 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Elective C	Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elec	ctive Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Electiv	e Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Cor			

Course L0395: Subsoil and U	nderground Engineering Law
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Günther Schalk
Language	DE
Cycle	WiSe
Content	History of Civil Engineering Law (from 1700 BC to 2000 AD)
	• Basics of foundation and excarvation law / engineering law (the participants in the case law of geotechnical law case studies)
	Legal aspects of technical regulations in civil engineering (with case studies)
	• The civil engineering contract (including checklists for the special civil engineering contract design and execution)
	• The liability of the planner and entrepreneur in civil engineering (practical examples, jurisprudence and law, inter alia, to the
	Ordinance on Combatants, liability for defects and traffic safety obligations, construction law and insurance questions)
	The ground / foundation risk and the systemic risk (also in the European context)
	The total debt in (low) building law (based on practice-oriented case constellations)
	• The (construction) conflict, the dispute avoidance models and the construction process (practice-oriented presentation)
Literature	Folienskript (in der Vorlesung erhältlich)
	weitere Literatur:
	Englert, Grauvogel und Maurer: Handbuch des Baugrund- und Tiefbaurechts. Werner-Verlag

Course L1906: Service Contra	ourse L1906: Service Contract and Procurement Law		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Günther Schalk, Prof. Jürgen Grabe		
Language	DE		
Cycle	WiSe		
Content			
Literature			

## Module Manual M.Sc. "Civil Engineering"

Course L0708: Project Geote	chnics
Тур	Project-/problem-based Learning
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	The students solve independently a project-based geotechnical problem in groups. Additional lectures concerning the problem will
	be held and material will be distributed as study basis. Every two weeks the groups present their current project status. The final
	work will be presentated in a final presentation.
Literature	abhängig von der Fragestellung

Courses						
Title				ур	Hrs/wk	СР
Waste and Environmental Chemist Biological Waste Treatment (L0318	-			ractical Course roject-/problem-based Learning	2	2 4
-			i	roject-/problem-based Leanning	5	-
Module Responsible						
Admission Requirements						
	chemical and biological bas	SICS				
Knowledge						
Educational Objectives	After taking part successful	lly, students have r	reached the following	learning results		
Professional Competence						
Knowledge	The module aims possess k design and layout of anaero	Ū.		iological waste treatment pla s in detail, describe different		
	plants for biological waste t	treatment plants a	nd explain different r	nethods for waste analytics.		
51.77	-		1			
SKIIIS	The students are able to di				-	
	control measurements. The students can recherché and evaluate literature and date connected to the tasks given in der modul- and plan additional tests. They are capable of reflecting and evaluating findings in the group.					
	and plan additional tests. T		Teneeting and evalu	ating mangs in the group.		
Personal Competence						
Social Competence	ce Students can participate in subject-specific and interdisciplinary discussions, develop cooperated solutions and defend t					
			the scientific develo	opment in front of colleague	es. Furthermore	e, they can give a
	accept professional constructive criticism.					
4	Chudaata aan indaacadaati		ana literatura burin			
Autonomy	Students can independent					
	are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define further					
	steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in acco potential social, economic and cultural impact.				accordance with	
	potential social, economic t					
	Independent Study Time 12	10, Study Time in L	ecture 70			
Credit points						
Course achievement		i ject theoretical	Description and			
		ctical work	anu			
Examination						
Examination duration and		n (15-25 minutes	in groups)			
scale	Elaboration and Presentation	517 (12-52 Hillinges I	in groups/			
Assignment for the	Civil Engineering: Specialis	ation Structural En	aineering: Flective C	ompulsory		
Following Curricula	5 5 1		5 5	1 3		
	Civil Engineering: Specialis					
	Civil Engineering: Specialis	Ū.	•			
				tal Engineering: Elective Cor	npulsory	
	Environmental Engineering			5 5	. ,	
				gy and Environmental Engine	eering: Elective	Compulsory
	-					
	Joint European Master in Er	vironmental Studie	es - Cities and Sustai	nability: Specialisation Energ	y: Elective Com	ipulsory
	Joint European Master in Er Water and Environmental E				y: Elective Com	ipulsory

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	DE/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	ourse 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	<ol> <li>Introduction</li> <li>biological basics</li> <li>determination process specific material characterization</li> <li>aerobic degradation ( Composting, stabilization)</li> <li>anaerobic degradation (Biogas production, fermentation)</li> <li>Technical layout and process design</li> <li>Flue gas treatment</li> <li>Plant design practical phase</li> </ol>		
Literature			

Module M1716: Subsi	Irface Processes			
Courses				
Title		Тур	Hrs/wk	СР
Modeling of Subsurface Processes	L2730)	Lecture	2	2
Modeling of Subsurface Processes	L2731)	Recitation Section (small)	1	1
Modern Techniques for Subsurface	Solute Transport (L2728)	Lecture	2	2
Modern Techniques for Subsurface	Solute Transport (L2729)	Recitation Section (large)	1	1
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
<b>Recommended Previous</b>				
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 96, Study Time in Le	ecture 84		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural En	igineering: Elective Compulsory		
-	Civil Engineering: Specialisation Geotechnica			
-	Civil Engineering: Specialisation Coastal Engi	neering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Ti	raffic: Elective Compulsory		
	Process Engineering: Specialisation Environm	ental Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process E	ingineering: Elective Compulsory		
	Water and Environmental Engineering: Specia	alisation Water: Compulsory		
	Water and Environmental Engineering: Specia	alisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Specia	alisation Cities: Elective Compulsory		

Course L2730: Modeling of Subsurface Processes		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Alexandru Tatomir	
Language	EN	
Cycle	WiSe	
Content		
Literature		

Course L2731: Modeling of S	urse L2731: Modeling of Subsurface Processes				
Тур	Recitation Section (small)				
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				

Course L2728: Modern Techr	ourse L2728: Modern Techniques for 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				
Literature				

Course L2729: Modern Techniques for 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		

Courses					
<b>Fitle</b>			Тур	Hrs/wk	СР
Concrete Structures (L0579)			Seminar	1	1
Structural Concrete Members (L0577)			Lecture	2	3
Structural Concrete Members (L05	- ,		Recitation Section (large)	2	2
Module Responsible		ch			
Admission Requirements	None				
<b>Recommended Previous</b>	Basics of structural a	analysis, conception and	d dimensioning of structural concrete		
Knowledge	Modules: Reinforced	Concrete Structures I+	II, Structural Analysis I+II, Mechanics I+II		
			.,		
Educational Objectives	After taking part suc	cessfully, students have	e reached the following learning results		
Professional Competence					
Knowledge	The students broade	en their skills in structur	al engineering, especially in the field of buildin	gs (houses, roofs, h	alls). They dispos
-			in of concrete buildings and structural members		
	-				
Skills	Skills The students are able to apply procedures of the conception and dimensioning to to practical problems of structural enginee They are capable to draft concrete buildings and to design them for general action effects and to plan their detailing				ructural engineer
					n their detailing
	execution. Moreover	r, they can make design	and construction sketches and draw up techni	cal descriptions.	
Personal Competence					
-	The students are ab	le to obtain results of hi	gh guality in teamwork.		
	The students are able to obtain results of high quality in teamwork.				
Autonomy	The students are ab	le to carry out complex	conception and dimensioning tasks of structure	es under the guidan	ce of tutors.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
Credit points					
	Compulsory Bonus	Form	Description		
		Presentation	Es werden 2 Referate ausgegeben		
Course achievement	Yes None	ricscritation	L3 Werden z hererate ausgegeben		
		resentation			
Course achievement	Yes None Written exam	Tresentation	Es werden zikerende dusgegeben		
Course achievement Examination	Yes None Written exam				
Course achievement Examination Examination duration and scale	Yes None Written exam 120 minutes		Engineering: Compulsory		
Course achievement Examination Examination duration and scale	Yes None Written exam 120 minutes Civil Engineering: Sp	pecialisation Structural E			
Course achievement Examination Examination duration and scale Assignment for the	Yes None Written exam 120 minutes Civil Engineering: Sp Civil Engineering: Sp	pecialisation Structural E pecialisation Geotechnic	Engineering: Compulsory		
Course achievement Examination Examination duration and scale Assignment for the	Yes None Written exam 120 minutes Civil Engineering: Sp Civil Engineering: Sp Civil Engineering: Sp	pecialisation Structural E pecialisation Geotechnic pecialisation Coastal Eng	Engineering: Compulsory al Engineering: Elective Compulsory		

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	Prof. Günter Rombach
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	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Günter Rombach	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses Title							
					T	Line (mile	СР
					Typ Lecture	Hrs/wk	3
Computational Analysis of Concrete Structures (L0598)				Recitation Section (large)	1	1	
Computational Analysis of Concrete Structures (L0599) FE-Modeling of Concrete Structures (L0600)				Project-/problem-based Learning	2	2	
Module Responsible	Prof. Günte	r Romba	ch				
Admission Requirements	None						
<b>Recommended Previous</b>	Basic know	ledge in s	structural analysis and	design of reinforced co	oncrete structures (beams, slab	s, shear walls)	).
Knowledge	Lectures '0	Concrete	Structures I und II'				
	Lectures 'S	Structural	Analysis I and II'				
	Lecture 'Co	ncrete St	ructures'				
Educational Objectives	After taking part successfully, students have reached the following learning results						
<b>Professional Competence</b>							
Knowledge	The students know the problems of numerical modeling and design of an arbitrary concrete structure.						
Skills	The students can model and design an arbitrary concrete structure by means of a finite element software package.						
Personal Competence							
Social Competence	The students can model and design in teamwork a real concrete structure by means of a finite element software package.						
Autonomy	The students can model and design a real concrete structure based on a finite element software package and discuss the probler						
-	and results with other students.						
		nt Study 1	Time 110, Study Time i	in Lecture 70			
	6		_				
course achievement	Compulsory Yes	None	Form Excercises	Description	system mit TEDDY zu modellier	on	
	Yes		Attestation	-	•		ochonprogramm
	Tes	None	Allestation	modellieren	s Semster ist ein Tragsystem	i mit dem k	echenprogramm 2
Examination	Oral exam						
Examination duration and	45 min						
scale							
Assignment for the	Civil Engine	eering: Sp	ecialisation Structural	Engineering: Elective (	Compulsory		
Following Curricula	-	• •					
-	-	• •	: Specialisation Coastal Engineering: Elective Compulsory				

Course L0598: Computationa	I Analysis of Concrete Structures
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Content	<ul> <li>Modeling of beam and truss structures <ul> <li>Discontinuity regions, like frame corners, openings, shear walls with large openings</li> <li>Bracing of high-rise buildings</li> <li>Modeling of bridges</li> <li>Nonlinear analysis</li> </ul> </li> <li>Finite-Elemente-analysis of slabs: support conditions, singularity regions</li> <li>Finite-Elemente-Berechnungen of shear walls and deep beams: support condition, design</li> <li>Coupled systems</li> <li>Modeling of slab supported on beams</li> <li>Shell structures</li> <li>3D building models</li> <li>Nonlinear analysis of slabs and shells</li> <li>Documentation</li> </ul>
Literature	<ul> <li>Vorlesungsumdruck</li> <li>Rombach, G.A. (2007): Anwendung der Finite-Elemente-Methode im Betonbau. 2. Auflage, Verlag Ernst &amp; Sohn, Berlin</li> <li>Rombach G.A. (2011): Finite-Element Design of Concrete Structures, 2nd edition, ICE publishing</li> <li>Hartmann, F., Katz, C. (2002): Statik mit finiten Elementen. Springer, Berlin</li> </ul>

Course L0599: Computationa	urse L0599: Computational Analysis of Concrete Structures				
Тур	Recitation Section (large)				
Hrs/wk	1				
СР	1				
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14				
Lecturer	Prof. Günter Rombach				
Language	DE				
Cycle	WiSe				
Content	See interlocking course				
Literature	See interlocking course				

Course L0600: FE-Modeling o	of Concrete Structures
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Lukas Henze
Language	DE
Cycle	WiSe
Content	Finite Element Modeling and computational design of concrete structures by 'SOFiSTiK'
Literature	<ul> <li>Rombach G.: Anwendung der Finite - Elemente - Methode im Betonbau. 2. Auflage. Verlag Ernst &amp;.Sohn, Berlin, 2007</li> <li>Rombach G.: Finite-Element Design of Concrete Structures. 2nd edition, ICE Publishing, London, 2011, ISBN 0 7277 32749</li> <li>Rombach G.: EDV-unterstützte Berechnungen im Stahlbetonbau. in: "Stahlbetonbau aktuell 2014" (ed. Gorris A., Hegger J., Mark P.), Berlin 2014 (S. C1C.36)</li> </ul>

Courses			
Title Integrated Transportation Planning	(L1068) Typ Project-/problem-1	Hrs/wk	<b>CP</b> 6
Module Responsible		Jased Learning 4	0
Admission Requirements			
Recommended Previous		cc Transport Planning and I	Fraffic Engineerin
Knowledge	some knowledge of transport planning, e.g. through taking the undergraduate cla		
<b> </b>	After taking part successfully, students have reached the following learning result	5	
Professional Competence			
•	Students are able to:		
	<ul> <li>describe interdependencies between land-use/location choice and transpor</li> <li>explain and evaluate the social, ecological and economic effects of transpo</li> <li>relate current issues in the area of integrated transport planning and formute</li> </ul>	rt and land-use policy measu	ures.
Skills	Students are able to: • quantify important parameters, which influence travel demand or are influe	-	
	<ul> <li>comprehensively examine a pre-defined or self-selected topic from a trans results in accordance with scientific conventions.</li> </ul>	portation studies perspectiv	ve and document t
Personal Competence			
Social Competence	Students are able to:		
	<ul> <li>provide feedback on topical contents and their teaching.</li> </ul>		
	<ul> <li>constructively handle feedback on their own work.</li> </ul>		
	<ul> <li>produce results in group work and document these.</li> </ul>		
Autonomy	Students are able to:		
	<ul> <li>assess potential consequences of their future professional activities</li> </ul>		
	<ul> <li>independently plan working on a pre-defined project topic, acquire the nec</li> </ul>	essary knowledge and use a	ppropriate means f
	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 scale	written assignment with presentation during the semester		
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: El	ective Compulsory	
	Water and Environmental Engineering: Specialisation Water: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Environment: Elective Comp	oulsory	
	Water and Environmental Engineering: Specialisation Cities: Compulsory		

Course L1068: Integrated Transportation 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 (2005) Entwicklung innovativer Verkehrsstrategien für die mobile Gesellschaft. Erich Schmidt Verlag. Berlin. Bracher, Tilman u. a. (Hrsg.) (68. Ergänzung 2013) 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	205)	Recitation Section (large)	2	2
Steel Bridges (L1097)		Lecture	2	2
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
<b>Recommended Previous</b>	Basics of steel construction (i.e. Steel Structures I and II, BUBC)	)		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	After successful completition, students can			
	<ul> <li>describe the phenomenon of local buckling</li> </ul>			
	<ul> <li>explain warping torsion</li> </ul>			
	<ul> <li>illustrate the behaviour of composite structures</li> </ul>			
	<ul> <li>specify the principles in design of composite structures</li> </ul>			
	<ul> <li>sketch the contructions of steel and composite bridges</li> </ul>			
Skills	After successful participation students are able to			
	<ul> <li>check stiffened and unstiffened plated structures</li> </ul>			
	<ul> <li>recognize and verify warping tosion in strucures</li> </ul>			
	design composite structures			
	<ul> <li>design bridges and o perform the detailing</li> </ul>			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Compu	Ilsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elec	ctive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective C	Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Cor	npulsory		
	International Management and Engineering: Specialisation II. C	ivil Engineering: Elective Comp	oulsory	

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	<ul> <li>Local-buckling of plated structures</li> <li>Warping torsion</li> <li>Composite-girders, -columns, -slabs, -bridges</li> <li>Principles in composite constructions</li> <li>Bridge-design and -construction</li> </ul>	
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 Cor	rse L1205: Steel and Composite Structures	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	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
	Independent Study Time 32, Study Time in Lecture 28
Lecturer	
Language	
Cycle	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
	<ul> <li>Ahlgrimm, J., Lohrer, I.: Erneuerung der Eisenbahnüberführung in Fulda-Horas über die Fulda, Stahlbau 74 (2005), Heft 2, S. 114</li> </ul>

#### Module M0969: Selected Topics in Civil Engineering Courses Title Тур Hrs/wk CP 2 Eraonomics (L0653) Lecture 3 Analysis of Offshore Structures (L1867) Lecture 1 1 Excellence in International Project Delivery (L2387) Integrated Lecture 2 2 Design of Prefabricated Concrete Structures (L0596) Lecture 1 1 Design of Prefabricated Concrete Structures (L0597) Recitation Section (large) 1 1 Forum I - Geotechnics and Construction Management (L1634) Seminar 1 1 Forum II - Geotechnics and Construction Management (L1635) Seminar 1 1 2 3 Geotechnical Engineering Design (L2447) Lecture Timber Structures (L1151) Seminar 2 2 Innovative Timber Construction (L2666) Lecture 2 3 Glass Structures (L1152) Lecture 2 2 Glass Structures (L1447) Recitation Section (large) 1 1 Testing and non-destructive examination of concrete members (L2725) Project-/problem-based Learning 2 2 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 reached the following learning results **Professional Competence** Knowledae • 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 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 Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory

Course L0653: Ergonomics	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and	30 min
scale	
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

# Module Manual M.Sc. "Civil Engineering"

Тур	Lecture
Hrs/wk	
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 L2387: Excellence in International Project Delivery	
Тур	Integrated Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	laut FSPO
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt
scale	
Lecturer	Dr. Jens Huckfeldt
Language	EN
Cycle	SoSe
Content	
Literature	

Course L0596: Design of Pre	fabricated Concrete Structures
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and	60 min
scale	
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	<ul> <li>application and advantages and disadvantages of precast concrete structures</li> <li>basics of design - precast element production - construction - tolerances</li> <li>elements of a warehouse</li> <li>design of a beam - joints</li> <li>design of D-regions: half joints, corbels, openings</li> <li>slab types - walls - facades</li> <li>footings: pocket and block foundations</li> <li>joints - connections</li> <li>shear design of the interface between concrete cast at different times</li> <li>unreinforced concrete structures</li> </ul>
Literature	<ul> <li>Bachmann H., Steinle A.; Hahn V.: Bauen mit Betonfertigteilen. Betonkalender 2009, Teil I, Verlag Ernst &amp; Sohn, Berlin</li> <li>Bindseil P.: Stahlbetonfertigteile. Werner Verlag, 1998</li> <li>FIP: FIP Handbuch für Planung und Entwerfen von Fertigteilbauten (siehe Zeitschrift: Beton- und Fertigteiltechnik ab 3/1996)</li> <li>Bergmeister K.: Konstruieren von Fertigteilen. Betonkalender 2005 Teil 2, S. 163-240</li> <li>Reineck KH.: Modellierung der D-Bereiche von Fertigteilen. Betonkalender 2005 Teil 2, S. 241-296</li> <li>Graubner CA. et. al.: Bemessung von Fertigteilen nach DIN 1045-1. Betonkalender 2005 Teil 2, S. 297-374</li> </ul> Broschüren der Fachvereinigung Deutscher Betonfertigteilbau e.V. siehe: www.fdb-fertigteilbau.de

Course L0597: Design of Prefabricated Concrete Structures	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and	Siehe korrespondierende Vorlesung
scale	
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

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 L2447: Geotechnical	Engineering Design
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and	45 Min.
scale	
Lecturer	Prof. Jürgen Grabe, Dr. Tim Pucker
Language	DE
Cycle	WiSe
Content	The focus of the course is on the design of geotechnical structures. Methods and fundamental approaches for the successful processing of geotechnical designs are taught. Theoretical approaches are backed up with examples from everyday work in industry. In parallel to the theoretical content, students are given a practical task for a geotechnical design at beginning of the course, which will be worked on in small teams. In addition to the application of the already acquired technical knowledge, topics like realisation, construction sequence planning, cost calculation, optimisation and evaluation criteria are also part of the course. The event will be finished with the presentation of the designs.
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
CP	3
Workload in Hours	Independent Study Time 62, 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	
	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 L2725: Testing and non-destructive examination of concrete members	
Тур	Project-/problem-based Learning
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	Prof. Günter Rombach, Dr. Lukas Henze
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	laut FSPO
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	laut FSPO
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	laut FSPO
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.

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Course L2789: Structural Design	
	Seminar
Hrs/wk	
CP	
-	- Independent Study Time 32, Study Time in Lecture 28
Examination Form	
Examination duration and	
scale	
Lecturer	Dr. Jan Mittelstädt
Language	DE/EN
Cycle	
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	Prof. Peter Fröhle		
Admission Requirements	None		
<b>Recommended Previous</b>	Subjects of the Port and Coastal Engineering specialisation.		
Knowledge			
Educational Objectives	After taking part successfully, students have reached the following learning results		
<b>Professional Competence</b>			
Knowledge	e The students are able to demonstrate their detailed knowledge in the field of port and coastal engineering. They can exe state of technology and application and discuss critically in the context of actual problems and general conditions of so society.		
	The students can develop solving strategies and approaches for fundamental and practical problems in port and c engineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view 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			
	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 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 scale	The number of pages depends on the task.		
Assignment for the Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Compulsory		

Courses				
		-	11	<u></u>
Fitle		Тур	Hrs/wk 2	<b>CP</b> 2
Plates and Shells (L1199) Nonlinear Analysis of Frame Struct	ure (I 1200)	Lecture	2	2
Nonlinear Analysis of Frame Struct		Recitation Section (large)	2	2
Module Responsible		······································	_	_
Admission Requirements				
	Mechanics I/II, Mathematics I/II, Differentia	al Equations I		
Knowledge	Mechanics I/II, Machematics I/II, Difference			
Kilowieuge				
Educational Objectives	After taking part successfully, students be	we reached the following learning results		
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				• -
Knowledge	After successful completion of this module	e, students can explain selected elements of hig	ner structural analys	ilS.
Skills				
	After successful completion of this modu	ile, the students are able to assess the premise	as and the applicable	ility of the proces
		They are able to use these methods for perform		
	methous of advanced structural analysis.	They are able to use these methods for perform	ing structural analys	
Personal Competence				
Social Competence	Students can			
	<ul> <li>participate in subject-specific and i</li> </ul>			
	defend their own work results in fro			
	promote the scientific development			
	<ul> <li>Furthermore, they can give and accord</li> </ul>	cept professional constructive criticism		
Autonomy	The students have the opportunity to volu	Intarily and independently work homework prob	ems.	
Workload in Hours		n Lecture 84		
Credit points				
Course achievement				
Examination				
Examination duration and	135 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structura			
Following Curricula	Civil Engineering: Specialisation Geotechr	nical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal E	ngineering: Elective Compulsory		

Lecturer Dr. Jürg Language DE Cycle WiSe Content Theory of G Content P A P S Content S Content S Co	ident Study Time 32, Study Time in Lecture 28
CP 2 Workload in Hours Indepen Lecturer Dr. Jürge Cycle WiSe Content Theory of Content Theory of Content A P S Content A P S Content A P S Content A P S Content S Content S Conte	en Priebe of plates loaded in-plane ioverning equations (equilibrium, kinematics, constitutive law) iifferential equation iry stress function lane stress / plane strain tructural behaviour of plates loaded in-plane Theory of plates in bending ioverning equations (equilibrium, kinematics, constitutive law) iifferential equation
Workload in Hours       Independence         Lecturer       Dr. Jürge         Language       DE         Cycle       WiSe         Content       Theory of         G       O         O       O         Independence       O         O       O         Independence       O         Content       Theory of         Independence       O         Independence        Indepe	en Priebe of plates loaded in-plane ioverning equations (equilibrium, kinematics, constitutive law) iifferential equation iry stress function lane stress / plane strain tructural behaviour of plates loaded in-plane Theory of plates in bending ioverning equations (equilibrium, kinematics, constitutive law) iifferential equation
Lecturer Dr. Jürg Language DE Cycle WiSe Content Theory of G Content P A P S Content S Content S Co	en Priebe of plates loaded in-plane ioverning equations (equilibrium, kinematics, constitutive law) iifferential equation iry stress function lane stress / plane strain tructural behaviour of plates loaded in-plane Theory of plates in bending ioverning equations (equilibrium, kinematics, constitutive law) iifferential equation
Language DE Cycle WiSe Content Theory of G D A P S S Content Content C Content C Content C C C C C C C C C C C C C C C C C C C	of plates loaded in-plane ioverning equations (equilibrium, kinematics, constitutive law) ifferential equation iry stress function lane stress / plane strain tructural behaviour of plates loaded in-plane Theory of plates in bending ioverning equations (equilibrium, kinematics, constitutive law)
Cycle WiSe Content Theory ( G D A P S S G D N A A S S Content Theory ( Content A P S S Content C P S S Content C P S S Content C C D C C D C C D C C D C C D C C D C C D C C D C C D C C C C C D C	ioverning equations (equilibrium, kinematics, constitutive law) ifferential equation iry stress function lane stress / plane strain tructural behaviour of plates loaded in-plane Theory of plates in bending ioverning equations (equilibrium, kinematics, constitutive law) ifferential equation
Content Theory ( G D A P S G D A P S S Content Theory ( Content Theory ( Content S Content S C	ioverning equations (equilibrium, kinematics, constitutive law) ifferential equation iry stress function lane stress / plane strain tructural behaviour of plates loaded in-plane Theory of plates in bending ioverning equations (equilibrium, kinematics, constitutive law) ifferential equation
• G • D • A • P • S • G • D • N • N • A • S • S • • P • • M • • F • • S	ioverning equations (equilibrium, kinematics, constitutive law) ifferential equation iry stress function lane stress / plane strain tructural behaviour of plates loaded in-plane Theory of plates in bending ioverning equations (equilibrium, kinematics, constitutive law) ifferential equation
• D • A • P • S • G • D • D • N • A • S • S • P • M • E • S • S • • P • • S	Differential equation iry stress function lane stress / plane strain tructural behaviour of plates loaded in-plane Theory of plates in bending ioverning equations (equilibrium, kinematics, constitutive law) Differential equation
• A • P • S • G • D • N • A • S • P • M • E • S	iry stress function lane stress / plane strain tructural behaviour of plates loaded in-plane Theory of plates in bending ioverning equations (equilibrium, kinematics, constitutive law) bifferential equation
• P • S • G • D • N • A • S • P • M • E • S	Jane stress / plane strain tructural behaviour of plates loaded in-plane Theory of plates in bending soverning equations (equilibrium, kinematics, constitutive law) bifferential equation
• S • G • D • N • A • S • P • M • E • S	tructural behaviour of plates loaded in-plane Theory of plates in bending Governing equations (equilibrium, kinematics, constitutive law) Differential equation
• G • D • N • A • S • P • M • E • S	Theory of plates in bending Governing equations (equilibrium, kinematics, constitutive law) Differential equation
• D • N • A • S • P • M • E • S • S	overning equations (equilibrium, kinematics, constitutive law) oifferential equation
• D • N • A • S • P • M • E • S • S	ifferential equation
• N • A • S • P • M • E • S • S	
• A • S • P • M • E • S	lavier solution / Fourier series expansion
• S • P • M • E • S	avier solution / Fourier series expansion
• P • M • E • S	pproximation procedures
• M • E • S	tructural behaviour of plates in bending
• M • E • S	Shell theory
• E • S • P	henomenona of the structural behaviour of shells
• S • P	lembrane and bending theory
• P	quilibrium equations of shells of revolution
	tress resultants and deformations of the spherical shell, the half spherical shell, and the cylindrical shell
	Stability problems (overview)
	late buckling
	hell buckling
Literature	
	asar, Y.: Krätzig, W.B. (1985): Mechanik der Flächentragwerke. Vieweg-Verlag, Braunschweig, Wiesbaden
• 2	asar, Y.: Krätzig, W.B. (1985): Mechanik der Flächentragwerke. Vieweg-Verlag, Braunschweig, Wiesbaden irkmann, K. (1963): Flächentragwerke, Springer Verlag, Wien, 1963, unveränderter Nachdruck 1986 ienkiewicz, O.C. (1977): The Finite Element Method in Enginieering Science. McGraw-Hill, London

Course L1200: Nonlinear Ana	alysis of Frame Structure
	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	WiSe
Content	-Types of nonlinearity
	-relevance of nonlinear effects on structural analysis
	-comparison and classification of 1 <sup>st</sup> order theory, 2 <sup>nd</sup> order theory and 3 <sup>rd</sup> order theory with regard to the coverage of geometric nonlinearity
	-fundamentals of 2 <sup>nd</sup> order elasticity theory for frame structures
	-application of 2 <sup>nd</sup> order elasticity theory using finite elements: common displacement method
	-fundamentals of analytical application of 2 <sup>nd</sup> order elasticity theory: derivation and solution of differential equation
	-structurally applied methods of analytical application of 2 <sup>nd</sup> order elasticity theory: common displacement method using analytical stiffness matrix, slope-deflection method for sway and non-sway frame structures, consideration of imperfections
	1 <sup>st</sup> order plastic hinge theory
Literature	Rothert, H.; Gensichen, V. (1987): Nichtlineare Stabstatik. Springer Verlag, Berlin

Course L1201: Nonlinear Ana	urse L1201: Nonlinear Analysis of Frame Structure		
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Uwe Starossek		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses				
Title		Тур	Hrs/wk	СР
Chemistry of Drinking Water Treatment (L0311)		Lecture	2	1
Chemistry of Drinking Water Treat	ient (L0312)	Recitation Section (large)	1	2
Water Resource Management (L04		Lecture	2	2
Water Resource Management (L04		Recitation Section (small)	1	1
Module Responsible				
Admission Requirements	None			
	Knowledge of water management and the key processes involved in water treatment.			
Knowledge	<u> </u>			
	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Skills	outline the organisational structures of water companies. They will be able to explain the available water treatment processes the scope of their application. Students will be able to assess complex problems in drinking water production and establish solutions involving management and technical measures. They will be able to assess the evaluation methods that can be used for this. Studen be able to carry out chemical calculations for selected treatment processes and apply generally accepted technical rule standards to these processes.		ions involving wa for this. Students	
Personal Competence				
Social Competence	Working in a diverse group of specialists, 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 u interests. They will be able to develop joint solutions in teams of diverse experts and present these solutions to others.			
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 i	n Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min (chemistry) + presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structura	l Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechr	nical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water an	d Traffic: Compulsory		
	Civil Engineering: Specialisation Coastal E	ngineering: Elective Compulsory		
	Energy and Environmental Engineering: S	pecialisation Energy and Environmental Engineer	ring: Elective Comp	ulsory
	International Management and Engineering	ng: Specialisation II. Energy and Environmental En	ngineering: Elective	Compulsory
	Water and Environmental Engineering: Sp	pecialisation Water: Compulsory		
	Water and Environmental Engineering: Sp	ecialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Sp	estalization Citizer Floctive 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	<ul> <li>MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John Wiley &amp; Sons, Hoboken, 2005.</li> <li>Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley &amp; Sons, New York, 1996.</li> <li>DVGW (Hrsg.): Wasseraufbereitung - Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004.</li> <li>Jensen, J. N.: A Problem Solving Approach to Aquatic Chemistry. John Wiley &amp; Sons, Inc., New York, 2003.</li> </ul>

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	<ul> <li>Aktuelle UN World Water Development Reports</li> <li>Branchenbild der deutschen Wasserwirtschaft, VKU (2011)</li> <li>Aktuelle Artikel wissenschaftlicher Zeitschriften</li> <li>Ppt der Vorlesung</li> </ul>

# Module Manual M.Sc. "Civil Engineering"

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
Scientific Working in Computationa	l Engineering (L2764)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
<b>Recommended Previous</b>	Basic knowledge in scientific writing. String interest in topics related to computing in civil engineering.			
Knowledge				
Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence				
	thinking, being able to accurately plan, implement and analyze scientific projects, such as prospective master theses. S scientific writing is of particular importance in this course, a scientific paper will be developed, which is a prerequisite for the examination. The paper will be written based on a project to be conducted within this course. Project meetings in small gro presentations, and critical discussions of scientific publications are further key activities.		requisite for the fir	
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture	2 56		
Credit points	6			
Course achievement	None			
	Written elaboration			
Examination				
	10 pages of work with 15-minute oral presentation			
Examination duration and scale				
Examination duration and scale Assignment for the	Civil Engineering: Specialisation Water and Traffic: E			
Examination duration and scale Assignment for the		eering: Elective Compulsory		

Course 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		

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			
<b>Recommended Previous</b>				
Knowledge	Hydrology, Hydraulic Engineering			
	<ul> <li>Hydromechanic, Hydraulics</li> <li>Fundamentals of Coastal Engineering, Coastal- and Floc</li> </ul>	and Protection		
	Hydrological Systems			
Educational Objectives	After taking part successfully, students have reached the foll	lowing learning results		
<b>Professional Competence</b>				
Knowledge	Climate protection and climate adaptation			
	<ul> <li>Insights into climate change and its regional character</li> </ul>	ristics - fundamentals, climate mode	lling / climate	models
	<ul> <li>Impacts of climate change on the components of the r</li> </ul>		ing, childre	
	<ul> <li>Fundamentals of analysis of climate data</li> </ul>			
	Consequences of the impact of the climate change			
	<ul> <li>Measures for climate adaptation</li> </ul>			
	Assessment, prioritization and communication of adap	otation measures		
	Fundamentals of the analysis of hydrometeorological	and hydrological data		
Skills				
SKIIS	<ul> <li>Critical thinking: analysis of processes and relations, a</li> </ul>	assessment of needs for action		
	Creative thinking: development of adaptation strategie			
	<ul> <li>Practical thinking: inclusion of restrictions, application</li> </ul>	on 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 discipl	lines		
	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 comp	lex task.		
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Elective	e Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: E			
	Civil Engineering: Specialisation Structural Engineering: Elect			
	Civil Engineering: Specialisation Water and Traffic: Elective C	Compulsory		
	Water and Environmental Engineering: Specialisation Cities: Water and Environmental Engineering: Specialisation Enviror			

Course L2291: Adaptation to	climate change in hydraulic engineering
	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	<ul> <li>Climate protection and climate adaptation</li> <li>Findings on climate change and its regional characteristics: fundamentals of climate change, climate modelling / climate models</li> <li>Impacts of climate change on the components of the regional hydrological cycle(climate science view)</li> <li>Fundamentals of the analysis of climate data</li> <li>Concequences of the impacts of climate change (ingenieering science view)</li> <li>Measures for climate change adaptation</li> <li>Assessment, prioritization and communication of measures</li> <li>Fundamentals of analysis of hydrometeorological and hydrological data</li> </ul>
Literature	Bereitgestellte eLearning Plattform

#### **Specialization Geotechnical Engineering**

#### Module M0699: Geotechnics III Courses Title Тур Hrs/wk СР Numerical Methods in Geotechnics (L0375) Lecture 3 3 2 2 Advanced Foundation Engineering (L0497) Lecture Advanced Foundation Engineering (L0498) Recitation Section (large) 1 1 Module Responsible Prof. Jürgen Grabe 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 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: Compulsory Following Curricula Civil Engineering: Specialisation Geotechnical Engineering: Compulsory Civil Engineering: Specialisation Coastal Engineering: Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory

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:
Literature	<ul> <li>numerical simulations</li> <li>numerical algorithms</li> <li>finite element method</li> <li>application of finite element method in geomechanics</li> <li>constitutive models for soils</li> <li>contact models for soil structure interaction</li> <li>selected applications</li> <li>Wriggers P. (2001): Nichtlineare Finite-Elemente-Methoden, Springer Verlag, Berlin</li> <li>Bathe Klaus-Jürgen (2002): Finite-Elemente-Methoden. Springer Verlag, Berlin</li> </ul>

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

Course L0498: Advanced Fou	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
Non destructive testing of material	and parts (L2215)	Lecture	2	2
Non destructive testing of material		Project-/problem-based Learning	3	3
Non destructive testing of material	and parts (L2216)	Recitation Section (large)	1	1
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Written document about theory and praxis			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Elective Co	mpulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Elective Co	mpulsory		
	Civil Engineering: Specialisation Geotechnical Engineering: Electi	ve Compulsory		
	Civil Engineering: Specialisation Geotechnical Engineering: Electi	ve Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elective	Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elective	Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Comp	oulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Comp	oulsory		
	Materials Science: Specialisation Engineering Materials: Elective (	Compulsory		

Course L2215: Non destructi	ve testing of materials and parts
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Robert Meißner, Prof. Marcus Rutner
Language	DE/EN
Cycle	WiSe
Content	This strongly interdisciplinary lecture and practical course is offered to Masterstudents who are interesed to learn about an
	important field across engineering and material science industries, i.e. nondestructive testing of materials and parts. Interdisciplinary approaches and thinking becomes more and more important since many problems extend into various disciplines, hence, can only be solved through interdisciplinary thinking and collaboration. Accordingly, this module combines the efforts of 4 different disciplines, i.e. mechanical engineering, civil engineering, materials science and computer science with a touch of electrical engineering. Nondestructive testing (NDT) is the process of inspecting, testing, and evaluating materials, parts, and assemblies to understand properties and defects without causing damage to the material or part. This scientific approach enables to make intrinsic material and component characteristics visible. Hence, the approach links detection approaches (e.g. linear and nonlinear acoustic methods, ultrasonic testing, Magnetic Particle Testing, thermo-chemical methods, etc.) with material physics and the mechanics of components, further, with evaluation, interpretation, big data management, transmission of data, and cybersecurity. The module embraces a lecture and a practical course. Contents of the lecture are NTD technologies and their theory behind, evaluation, transmission of data, while the students will apply the NDT technologies during the practical course in the experimental test halls and labs at TUHH. Lecture and practical course split into the major themes: A) Detection: Theory and Practice B) Evaluation of Data: Theory and Practice C) Data Acquisition and Transmission with Wireless, Batteryless Sensor Devices:Theory and Practice
Literature	

Course L2217: Non destructi	ourse L2217: Non destructive testing of materials and parts		
Тур	Project-/problem-based Learning		
Hrs/wk	3		
СР	3		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Robert Meißner, Prof. Marcus Rutner		
Language	DE/EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L2216: Non destructi	ve testing of materials and parts
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Robert Meißner, Prof. Marcus Rutner
Language	DE/EN
Cycle	WiSe
Content	This strongly interdisciplinary lecture and practical course is offered to Masterstudents who are interesed to learn about an
	important field across engineering and material science industries, i.e. nondestructive testing of materials and parts.
	Interdisciplinary approaches and thinking becomes more and more important since many problems extend into various disciplines,
	hence, can only be solved through interdisciplinary thinking and collaboration. Accordingly, this module combines the efforts of 4
	different disciplines, i.e. mechanical engineering, civil engineering, materials science and computer science with a touch of
	electrical engineering. Nondestructive testing (NDT) is the process of inspecting, testing, and evaluating materials, parts, and
	assemblies to understand properties and defects without causing damage to the material or part. This scientific approach enables
	to make intrinsic material and component characteristics visible. Hence, the approach links detection approaches (e.g. linear and
	nonlinear acoustic methods, ultrasonic testing, Magnetic Particle Testing, thermo-chemical methods, etc.) with material physics
	and the mechanics of components, further, with evaluation, interpretation, big data management, transmission of data, and
	cybersecurity. The module embraces a lecture and a practical course. Contents of the lecture are NTD technologies and their
	theory behind, evaluation, transmission of data, while the students will apply the NDT technologies during the practical course in
	the experimental test halls and labs at TUHH. Lecture and practical course split into the major themes: A) Detection: Theory and
	Practice B) Evaluation of Data: Theory and Practice C) Data Acquisition and Transmission with Wireless, Batteryless Sensor
	Devices:Theory and Practice
Literature	

Module MU858: Coast	al Hydraulic Engineering I			
Courses				
Title		Тур	Hrs/wk	СР
Basics of Coastal Engineering (L08	)7)	Lecture	3	4
Basics of Coastal Engineering (L14	3)	Project-/problem-based Learning	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
<b>Recommended Previous</b>	Basics of hydraulic engineering, hydrology and hy	/dromechanics		
Knowledge				
Educational Objectives	After taking part successfully, students have read	hed the following learning results		
<b>Professional Competence</b>				
Knowledge	The students are able to define and explain the b	asic concepts of coastal engineering and port e	engineering. T	hey are able to ap
	the concepts to selected practical problems of c	oastal engineering. Students can define and de	etermine the I	basics for design a
	dimensioning of coastal engineering construction	S.		
Skills	The students are capable to apply basic design a	pproaches to selected and pre-defined design ta	asks in coasta	l engineering.
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in applied problems such as the design of coastal protection structu		protection structur	
	Additionaly, they will be able to work in team with	n engineers of other disciplines, for instance de	signing of coa	stal breakwaters.
A	The shudents will be able to independently autom			
Autonomy	The students will be able to independently extend	a their knowledge and applyit to new problems.		
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	The duration of the examination is 2 hours. Th	e examination includes tasks with respect to	the general i	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 Eng	gineering: Compulsory		
	Civil Engineering: Specialisation Coastal Engineer	ing: Compulsory		
	International Management and Engineering: Spec	ialisation II. Civil Engineering: Elective Compute	onv	

Course L0807: Basics of Coas	stal 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	DE
Cycle	WiSe
Content	<ul> <li>Basics of planning and design <ul> <li>Water levels</li> <li>Currents</li> <li>Waves</li> <li>Ice</li> </ul> </li> <li>Planning and Design in Coastal Engineering <ul> <li>Functional and constructional design</li> <li>Determination of design parameters</li> <li>Design-approaches</li> <li>Filter</li> <li>Rubble mound constructions</li> <li>Piles</li> <li>Vertical constructions</li> </ul> </li> </ul>
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	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M0964: Unde	rground Constructions				
Courses					
Title		Тур	Hrs/wk	СР	
Applied Tunnel Constructions (L240	7)	Lecture	2	3	
Introduction 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 environmental engineering:				
Knowledge					
	Geotechnics I-II				
	Steel Structures I-II				
Educational Objectives	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. The stude				
	get deeper knowledge of steel and ground engineering as well as constructions knowledge concerning quay walls. Futhermore, th				
	students get all the neccessary knowledge to design singular construction elements for sheet pile walls and they know how t				
	choose the right construction elements depending on the influencing conditions.				
Skills	s Basic knowledge of tunnel design as well as practical skills in structural tunnel analysis. 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 elemen				
Personal Competence					
	Capacity for teamwork concerning project management and design of tunnels.				
		vork flow in the framework of a design exercise.			
Workload in Hours					
Credit points					
Course achievement					
Examination	Written exam				
Examination duration and	120 minutes				
scale					
Assignment for the	Civil Engineering: Specialisation Structura	al Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Compulsory				
-	Civil Engineering: Specialisation Coastal Engineering: Compulsory				
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory				
	International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory				

Course L2407: Applied Tunnel Constructions			
Тур	ture		
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 to tunnel construction				
Тур	Lecture			
Hrs/wk	1			
CP	2			
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14			
Lecturer	Marius Milatz			
Language	DE			
Cycle	WiSe			
Content	Cycle       WiSe         Content <ul> <li>Definitions</li> <li>Historical development in tunneling</li> <li>Geology for tunneling</li> <li>Hard rock tunneling (construction composite and machines)</li> <li>Tunnelung in temporarly stable soil with conventional construction methods</li> <li>Tunneling in soft soils (form of supports, shield types, compressed air application)</li> <li>Pipe jacking</li> <li>Tunnel Lining, tunnel supporting structures</li> <li>Calculation approaches for supporting structures in shield-driven tunnels</li> <li>Surveying for tunneling</li> <li>Safety requirements</li> <li>Construction Contract</li> <li>Literature and sources</li> </ul>			
Literature	Vorlesung/Übung s. www.tu-harburg.de/gbt			

Course L1811: Introduction to tunnel construction			
Тур	citation Section (large)		
Hrs/wk			
CP			
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Marius Milatz		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M0511: Electr	ical Energy from Solar Radia	ation and Wind Power			
Courses					
Title		Тур	Hrs/wk	СР	
Sustainability Management (L0007)		Lecture	2	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. Isabel Höfer				
Admission Requirements	None				
<b>Recommended Previous</b>	Module: Technical Thermodynamics I,				
Knowledge	Modulo: Tochnical Thormodynamics II				
	Module: Technical Thermodynamics II,				
	Module: Fundamentals of Fluid Mechanics	5			
Educational Objectives	After taking part successfully, students h	ave reached the following learning results			
Professional Competence					
Knowledge	<ul> <li>By ending this module students can explain in detail knowledge of wind turbines with a particular focus of wind energy u offshore conditions and can critical comment these aspects in consideration of current developments. Furthermore, they are to describe fundamentally the use of water power to generate electricity. The students reproduce and explain the basic proce in the implementation of renewable energy projects in countries outside Europe.</li> <li>Through active discussions of various topics within the seminar of the module, students improve their understanding an application of the theoretical background and are thus able to transfer what they have learned in practice.</li> </ul>				
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					
A	Chulante and independently available available and with a the same hair of the last we material to also the same has a fit				
Autonomy	Students can independently exploit sources in the context of the emphasis of the lecture material to clear the contents of lecture and to acquire the particular knowledge about the subject area.				
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84			
Credit points					
-	None				
Examination					
		tion (incl. procentation) in sustainability mana	comont		
	2.5 hours whiteh exam + whiteh elabora	ation (incl. presentation) in sustainability mana	igement		
scale					
Assignment for the Following Curricula	Civil Engineering: Specialisation Structura Civil Engineering: Specialisation Geotech				
Tonowing curricula					
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory				
	Energy and Environmental Engineering: Specialisation Energy 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: Specialisation Product Development: Elective Compulsory Product Development, Materials and Production: Specialisation Production: Elective Compulsory				
	Product Development, Materials and Production: Specialisation Production: Elective Compulsory				
	Renewable Energies: Core qualification: Compulsory				
	Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory				
	Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory				
	Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory				
	Water and Environmental Engineering: Specialisation Environment: Compulsory				

Course L0007: Sustainability	Management
Тур	Lecture
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Anne Rödl
Language	DE
Cycle	SoSe
Content	The lecture "Sustainability Management" gives an insight into the different aspects and dimensions of sustainability. First, essential terms and definitions, significant developments of the last years, and legal framework conditions are explained. The various aspects of sustainability are then presented and discussed in detail. The lecture mainly focuses on concepts for the implementation of the topic sustainability in companies:
	<ul> <li>What is "sustainability"?</li> <li>Why is this concept an important topic for companies?</li> <li>What opportunities and business risks are addressed or are associated with it?</li> <li>How can the often mentioned three pillars of sustainability - economy, ecology, and social- be meaningfully integrated into corporate management despite their sometimes contradictory tendencies, and how a corresponding compromise can be found?</li> <li>What concepts or frameworks exist for the implementation of sustainability management in companies?</li> <li>Which sustainability labels exist for products or companies? What do they have in common, and where do they differ?</li> <li>Furthermore, the lecture is intended to provide insights into the concrete implementation of sustainability aspects into business practice. External lecturers from companies will be invited to report on how sustainability is integrated into their daily processes.</li> <li>In the course of an independently carried out group work, the students will analyze and discuss the implementation of sustainability aspects based on short case studies. By studying and comparing best practice examples, the students will learn about corporate decisions' effects and implications. It should become clear which risks or opportunities are associated if sustainability aspects are taken into account in management decisions.</li> </ul>
Literature	Die folgenden Bücher bieten einen Überblick: Engelfried, J. (2011) Nachhaltiges Umweltmanagement. München: Oldenbourg Verlag. 2. Auflage Corsten H., Roth S. (Hrsg.) (2011) Nachhaltigkeit - Unternehmerisches Handeln in globaler Verantwortung. Wiesbaden: Gabler Verlag.

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

Course L0011: Wind Turbine	Plants	
Тур	cture	
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	<ul> <li>Historical development</li> <li>Wind: origins, geographic and temporal distribution, locations</li> <li>Power coefficient, rotor thrust</li> <li>Aerodynamics of the rotor</li> <li>Operating performance</li> <li>Power limitation, partial load, pitch and stall control</li> <li>Plant selection, yield prediction, economy</li> <li>Excursion</li> </ul>	
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	<ul> <li>Introduction, importance of offshore wind power generation, Specific requirements for offshore engineering</li> <li>Physical fundamentals for utilization of wind energy</li> <li>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</li> <li>Foundation engineering, offshore site investigation, presentation of different concepts of offshore foundation structures, planning and fabrication of foundation structures</li> <li>Electrical infrastructure of an offshore wind farm, Inner Park cabling, offshore substation, grid connection</li> <li>Installation of offshore wind farms, installation techniques and auxiliary devices, construction logistics</li> <li>Development and planning of offshore wind farms</li> <li>Operation and optimization of offshore wind farms</li> <li>Day excursion</li> </ul>
Literature	<ul> <li>Gasch, R.; Twele, J.: Windkraftanlagen - Grundlagen, Entwurf, Planung und Betrieb; Vieweg + Teubner, Stuttgart, 2007, 7. Auflage</li> <li>Molly, J. P.: Windenergie - Theorie, Anwendung, Messung; C. F. Müller, Heidel-berg, 1997, 3. Auflage</li> <li>Hau, E.: Windkraftanlagen; Springer, Berlin, Heidelberg, 2008, 4.Auflage</li> <li>Heier, S.: Windkraftanlagen - Systemauslegung, Integration und Regelung; Vieweg + Teubner, Stuttgart, 2009, 5. Auflage</li> <li>Jarass, L.; Obermair, G.M.; Voigt, W.: Windenergie: Zuverlässige Integration in die Energieversorgung; Springer, Berlin, Heidelberg, 2009, 2. Auflage</li> </ul>

Courses				
Title		Тур	Hrs/wk	СР
Digital Building (L1908)		Lecture	2	2
Lean Construction (L1910)		Lecture	2	2
System Dynamics (L1909)		Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge				
Educational Objectives	After taking part successfully, studen	ts have reached the following learning results		
<b>Professional Competence</b>				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Ti	me in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coas	tal Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geot	echnical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Strue	ctural Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Wate	ar and Traffic: Elective Compulsory		

Course L1908: Digital Building	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Katja Maaser
Language	DE
Cycle	SoSe
Content	
Literature	

Course L1910: Lean Construction	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Theo Herzog
Language	DE
Cycle	SoSe
Content	
Literature	

ourse L1909: System Dynamics	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Markus Salge
Language	DE
Cycle	SoSe
Content	
Literature	

## 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	ıre	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					
<b>Recommended Previous</b>	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 dis	-	nd and adjust their	results. The students are	able to manu	ifacture their spec
	building material on the basis o	f this feedback.				
Autonomy	The students are able to respo	nsibly use the reso	ources of materials a	and lab equipment for thei	r 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 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 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 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
	Multiphase Flow in Porous Media (L2738)	Recitation Section (small)	2	2
Fundamentals of Multiphase Flow in Fundamentals of Multiphase Flow in		Lecture Recitation Section (large)	2	2
Module Responsible		Recitation Section (large)	Z	Z
Admission Requirements				
Recommended Previous				
Knowledge				
	After taking part successfully, students have reach	ed the following learning results		
Professional Competence	siter taking part successions, stadents have reach			
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture	84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engin	neering: Elective Compulsory		
	Civil Engineering: Specialisation Geotechnical Engin	neering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory		
	Environmental Engineering: Specialisation Water: E	lective Compulsory		
	Environmental Engineering: Specialisation Water: E	lective Compulsory		
	Water and Environmental Engineering: Specialisati			
	Water and Environmental Engineering: Specialisati			
	Water and Environmental Engineering: Specialisati			
	Water and Environmental Engineering: Specialisati			
	Water and Environmental Engineering: Specialisati			
	Water and Environmental Engineering: Specialisati	on Water: Elective Compulsory		

Course L2738: Advanced Modeling Techniques for Multiphase Flow in Porous Media		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Alexandru Tatomir	
Language	EN	
Cycle	SoSe	
Content		
Literature		

Course L2736: Fundamentals of Multiphase Flow in Porous Media		
Тур	Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Alexandru Tatomir	
Language	EN	
Cycle	SoSe	
Content		
Literature		

Course L2737: Fundamentals	urse L2737: Fundamentals of Multiphase Flow in Porous Media		
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Hannes Nevermann		
Language	EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

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	Prof. Günter Rombach			
Admission Requirements	None			
<b>Recommended Previous</b>	Detailed knowledge on the design of conc	rete structures.		
Knowledge	Modules: Reinforced Concrete Structures I+II, Structural Analysis I+II, Mechanics I+II, Concrete Structures			
Educational Objectives	After taking part successfully, students ha	we 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 metho			asic design metho
	They can explain the design of a prestress	sed bridge.		
Skills	The students are able to design reinforced	d or prestressed concrete bridges.		
Personal Competence				
•	The students can design in teamwork a real concrete bridge.			
	-	-		
Autonomy	The students are able to design a prestressed concrete bridge and discuss the problems and results with other students.			
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	180 minutes			
scale				
Assignment for the	Civil Engineering: Specialisation Structura	l Engineering: Compulsory		
-	Civil Engineering: Specialisation Geotechn			
	Civil Engineering: Specialisation Coastal E	ngineering: Elective Compulsory		
	International Management and Engineerin	g: Specialisation II. Civil Engineering: Elective Com	nulcon	

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

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

Module M0756: Soil M	lechanics and	-Dynamics				
Courses						
Courses						
Fitle				Тур	Hrs/wk	СР
Soil Mechanics - Selected Topics (L	)374)			Lecture Lecture	2 3	2
Soil Dynamics (L0452) Experimental Researches in Geoted	bnics (10706)			Practical Course	1	2
Module Responsible					*	-
Admission Requirements	None					
Recommended Previous	modules: Mathemat	ics I-III, Mechanics I-II, G <sup>,</sup>	eotechnics I			
Knowledge	courses: Soil laborat	ory course, (Applied stru	uctural dynamics)			
Educational Objectives	After taking part suc	cessfully, students have	e reached the follow	ing learning results		
Professional Competence						
Knowledge	After the successful	completion of the modu	le the students sho	uld be able to:		
		to apply the basic equal		namic excitation and to d	start the relevant par	amotors
				nine soil dynamic characte		
		chine foundations to dyn				të them,
	•					
		hocks to perform vibration		uildinga		
		nocks in term to their eff	ect on people and i	bullaings,		
		ossibilities of isolation,			6 H H H H	
				evaluate earthquake in te		e and intensity,
				ity and the dynamic bedd		
	<ul> <li>to know the r mathematical</li> </ul>		a deformation acc	umulation due to cyclic lo	ading and to estimate	e these deformatio
	<ul> <li>to distinguish</li> </ul>	the area of application of	of the method of ela	astodynamics and plastoc	lynamics,	
	<ul> <li>to detect the</li> </ul>	undrained shear strengt	h as a function of a	number of state variable	S,	
	<ul> <li>to capture the</li> </ul>	e visous behaviour of co	hesive soils and to	consider the effects of cr	eep and rate-depend	ent shear strength
	calculations,					
	<ul> <li>to consider th</li> </ul>	e impact of the partly sa	aturated of a seepa	ge and shear strength.		
o						
Skills Personal Competence						
Personal Competence						
Social Competence Autonomy						
	Independent Study 7	Time 96, Study Time in L	ecture 84			
Credit points		Time 50, Study Time in E				
Course achievement	Compulsory Bonus	Form	Description			
	Yes 15 %	Subject theoretical practical work	l and			
Examination	Written exam					
Examination duration and scale	150 min					
Assignment for the	Civil Engineering, Sr	pecialisation Structural E	naineerina: Flective	Compulsory		
Following Curricula		pecialisation Geotechnica				
Following curricula	civil Engineering: 5p		ai Liigilleeliiig. Coll	ipuisoi y		

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:	
	- continuum mechanis	
	- constitutive modelling	
	- time and rate dependend material behavior of soils	
	- cyclic loading	
	- undrained conditions	
Literature	Kolymbas D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. Springer Verlag	

Course L0452: Soil Dynamics	i
Тур	Lecture
Hrs/wk	3
CP	2
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42
Lecturer	Alexander Chmelnizkij
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	<ul> <li>Das B.M.: Fundamentals of Soil Dynamics, Elsevier</li> <li>Empfehlungen des Arbeitskreises Baugrunddynamik. Hrsg. Deutsche Gesellschaft für Geotechnik (DGGT)</li> <li>Haupt W.: Bodendynamik. Vieweg und Teubner</li> <li>Meskouris K. und Hinzen KG.: Bauwerke und Erdbeben. Vieweg Verlag</li> <li>Studer J.A., Koller M.G. und Laue J.: Bodendynamik, Springer Verlag</li> </ul>

Course L0706: Experimental	Researches in Geotechnics
Тур	Practical Course
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Marius Milatz
Language	DE
Cycle	SoSe
Content	The students are supposed to:
	<ul> <li>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.</li> <li>gain insight into current soil mechanical research.</li> <li>plan, coordinate, perform and evaluate soil mechanical tests in a team.</li> <li>discuss, reflect, review and present the obtained results in a group.</li> </ul> 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.
	<ul> <li>Normen zu geotechnischen Versuchsgeräten und Versuchsverfahren:</li> <li>DIN 18135:2012-04: Baugrund, Untersuchung von Bodenproben -</li> <li>Eindimensionaler Kompressionsversuch, Deutsches Institut für</li> <li>Normung, e. V.</li> </ul>
	- 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
Boundary Element Methods (L0523			Lecture	2	3 3
Boundary Element Methods (L0524			Recitation Section	(large) 2	3
Module Responsible					
Admission Requirements	None				
	Mechanics I (Statics, Me Mathematics I, II, III (in		) and Mechanics II (Hydrostatics, Kinem l equations)	natics, Dynamics)	
Educational Objectives	After taking part succes	ssfully, students have	e reached the following learning results	;	
Professional Competence					
Knowledge	The students possess a overview of the theoret		ge regarding the derivation of the bou basis of the method.	indary element method ar	nd are able to give
Skills			gineering problems by formulating the resulting system of equations.	suitable boundary elemo	ents, assembling t
		to independently sol	ic problems to arrive at joint solutions. ve challenging computational problem re critically scrutinized.	is and develop own bound	dary element routin
Workload in Hours	Independent Study Time	ne 124, Study Time in	Lecture 56		
Credit points	6				
Course achievement		Form Midterm	Description		
Examination	Written exam				
Examination duration and scale	90 min				
Assignment for the	Civil Engineering, Speci	ialisation Structural F	ngineering: Elective Compulsory		
-			al Engineering: Elective Compulsory		
i onowing curricula			ineering: Elective Compulsory		
	Energy Systems: Core of	-			
		•	Specialisation Product Development and	d Production: Elective Com	pulsory
	Mechatronics: Specialis				
			tion: Core qualification: Elective Compu	ulsory	
			neering Science: Elective Compulsory		
	Theoretical Mechanical	Engineering: Technic	cal Complementary Course: Elective Co	mpulsory	

Course L0523: Boundary Eler	nent Methods
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Otto von Estorff
Language	EN
Cycle	SoSe
Content	- Boundary value problems
	- Integral equations
	- Fundamental Solutions
	- Element formulations
	- Numerical integration
	- Solving systems of equations (statics, dynamics)
	- Special BEM formulations
	- Coupling of FEM and BEM
	- Hands-on Sessions (programming of BE routines)
	- Applications
Literature	Gaul, L.; Fiedler, Ch. (1997): Methode der Randelemente in Statik und Dynamik. Vieweg, Braunschweig, Wiesbaden
	Bathe, KJ. (2000): Finite-Elemente-Methoden. Springer Verlag, Berlin

Course L0524: Boundary Eler	ourse L0524: Boundary Element Methods		
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Otto von Estorff		
Language	EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses				
Title		Тур	Hrs/wk	СР
Groundwater Modeling using Modflow (L0543)		Lecture	1 2	1 2
Groundwater Modeling using Modfl Modeling of Water Supply and Sew		Recitation Section (small) Project-/problem-based Learning	2	2
Module Responsible		· · · j · · · / · · · · · · · · · · · ·	_	-
Admission Requirements	None			
Recommended Previous	Groundwater			
Knowledge				
	<ul> <li>groundwater hydraulics and transport of s</li> </ul>	substances		
	Pipe Systems			
	Knowledge on urban water infrastructuu	res, in particular drinking water systemsand u	ırhan drainad	e systems includi
	special structures		and an analysis	
	<ul> <li>Hydraulics of drinking water supply syster</li> </ul>	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	The taking part succession, stadents have rea	ened the following learning results		
	The students are able to describe the modelling	of groundwater flow and transport as well as url	oan water infra	astructures. They o
-	carry out systems analyses and can detect technical and conceptual weak points within the systems in case studies. Besid			
	are able to analyse interdependencies of hydrau	lic and toxic phenomena in soil and water.		
Skills	Skills The students are able to construct and apply scientific groundwater models indipendently. They can work			
	and can compare or assess different solutions for existing problems by application of selected software produc			cts. The students a
	able to use different software solutions (e.g. EPA	NET, EPA-SWMM).		
Personal Competence				
Social Competence	Wird nicht vermittelt.			
Autonomy	Wird nicht vermittelt.			
Workload in House	Independent Study Time 110, Study Time in Lect	turo 70		
Credit points				
Course achievement				
Examination	Oral exam			
Examination duration and	20 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engin	eering: Elective Compulsory		
	Civil Engineering: Specialisation Geotechnical En	5 5 1 5		
Following Curricula				
Following Curricula	Civil Engineering: Specialisation Coastal Enginee	5 1 5		
Following Curricula	Civil Engineering: Specialisation Water and Traffi	ic: Elective Compulsory		
Following Curricula	5 5 1 5	ic: Elective Compulsory ation Water: Compulsory		

	Course L0543: Groundwater Mo
	Typ Le
	Hrs/wk 1
	<b>CP</b> 1
	Workload in Hours In
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Course L0544: Groundwater	ourse 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	ourse L0875: Modeling of Water Supply and Sewer 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, Weitere Mitarbeiter		
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)		Lecture	2	2
Urban Infrastructures (L0874)		Project-/problem-based Learning	2	4
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
<b>Recommended Previous</b>				
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 followin	g learning results		
Professional Competence				
Knowledge	Students can describe urban development corridors as well as cu	irrent 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 innovation	ns and explain why these contril	bute to the im	provement of urb
	life. They can, for example, derive and discuss measures for effec	ctive noise abatement.		
Skille	Students are able to develop specific solutions for correcting	na existina or future environ	ment-related	problems of urb
JKIIIS	development. They can define a range of conceptual and technica			
	paths. To solve specific urban environmental problems they can			
	context.			inclining the unb
Personal Competence				
-	The students can work together in international groups.			
Autonomy	Students are able to organize their work flow to prepare themselves for presentations and contributions to the discussions. The			
	can acquire appropriate knowledge by making enquiries independ	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 C	Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective	ve Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Cor	mpulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Comp	ulsory		
	Environmental Engineering: Core qualification: Elective Compulso	ory		
	Joint European Master in Environmental Studies - Cities and Susta	ainability: Core qualification: Cor	npulsory	
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure	e and Mobility: Elective Compuls	ory	
	Water and Environmental Environmental Consideration Environment	t. Elective Communication		
	Water and Environmental Engineering: Specialisation Environmen	it: Elective Compulsory		

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
Coastal- and Flood Protection (L080	08)	Lecture	2	3
Coastal- and Flood Protection (L14	L5)	Project-/problem-based Learning	1	1
Maintennance and Defence of Floo	d Protection Structures (L1411)	Lecture	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
<b>Recommended Previous</b>	Coastal Engineering I			
Knowledge				
Educational Objectives	After taking part successfully, students have reach	ed 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 protect			
	and are able to apply the aspects to practical co	bastal protection problems. They are able to	design and	dimension import
	coastal protection measures from the functional ar	d from the constructional point of view.		
Skills	Skills The students are able to select design approaches for the functional and constructional design of erosion and		and flood protect	
	measures and apply these approaches to practical	design tasks.		
Personal Competence				
Social Competence	The students are able to deploy their gained kno	wledge in applied problems such as the fund	ctional and co	onstructive design
···· ,···	coastal and flood protection structures. Additionaly			
Autonomv	The students will be able to independently extend	their knowledge and apply it to new problems.		
	Independent Study Time 110, Study Time in Lectur			
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and	The duration of the examination is 130 min. The	examination includes tasks with respect to	the general u	understanding of
scale	lecture contents and calculations tasks.		-	5
Assignment for the	Civil Engineering: Specialisation Structural Enginee	ring: Elective Compulsory		
Assignment for the				
-	Civil Engineering: Specialisation Geotechnical Engi	neering: Elective Compulsory		

Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
Content	Protection of sandy coasts
	• Codiment transport
	Sediment transport     Morphology
	Technical solution for the protection of sandy coasts
	Construction in direction of the coast
	<ul> <li>Constructions perpendicular to the coast</li> </ul>
	• 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
	Coastal Engineering Manual CEM

Course L1415: Coastal- and	ourse 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	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1411: Maintennance	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	DE
Cycle	SoSe
Content	<ul> <li>Dike protection</li> <li>Maintennance of flood protection measures</li> </ul>
Literature	Vorlesungsumdruck

Courses				
Title		Тур	Hrs/wk	СР
Harbour Engineering (L0809)		Lecture	2	2
Harbour Engineering (L1414) Port Planning and Port Constructio	N (1 0 2 7 0)	Project-/problem-based Learning Lecture	1 2	2
Module Responsible		Lecture	Z	Z
Admission Requirements				
•	Basics of coastal engineering			
Kecommended Previous Knowledge	basics of coastal engineering			
-	After taking part successfully, students have reached the following	na learnina results		
Professional Competence	After taking part successionly, statents have reached the following			
•	The students are able to define in details and to choose design approaches for the functional design of a port and apply them			
Khowledge	design tasks. They can design the fundamental elements of a po	•••	lesign of a po	it and apply then
	acsign tasks. They can acsign the fundamental elements of a pole.			
Skills	The students are able to select and apply appropriate approaches for the functional design of ports.			
Personal 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 disciplin	•	J	
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 examination includes tasks with respect to the general understanding of		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: Electi	ive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Compulsor	у		
	Civil Engineering: Specialisation Water and Traffic: Elective Com	pulsory		
	International Management and Engineering: Specialisation II. Civ	il Engineering: Elective Compuls	ory	
	Theoretical Mechanical Engineering: Technical Complementary C	Course: Elective Compulsory		

ourse L0809: Harbour Engineering	
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	<ul> <li>Fundamentals of harbor engineering <ul> <li>Maritime transportation and waterways engineering</li> <li>Ships</li> </ul> </li> <li>Elements of harbors <ul> <li>Harbor approaches and water-side harbor areas</li> <li>Terminal design and handling of cargo</li> <li>Quay-walls and piers</li> <li>Equipment of harbors</li> <li>Sluices and other special constructions</li> </ul> </li> <li>Connection to inland transportation / inland waterway transportation</li> <li>Protection of harbors <ul> <li>Breakwaters and Jetties</li> <li>Wave protection of harbors</li> </ul> </li> <li>Fishery and other small harbors</li> </ul>
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	

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

Courses				
Title		Тур	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			
<b>Recommended Previous</b>	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 in hydraulic engineering			
	Besides, they can describe the basic aspects of numerical modelling and actual numerical models for the simulation of			nulation of flows a
	waves.			
Skills	Students are able to apply hydrodynamic-numerical models to practical hydraulic engineering tasks.			
Personal Competence				
•	The students are able to deploy their gained knowledge in simple applied problems. Additionaly, they will be able to work in		able to work in tea	
,	with others.			
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				
Course achievement				
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			
	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural Engineering: E	lective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineerin	a: Elective Compulsory		

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	<ul> <li>Fundamentals of hydraulic models</li> <li>Model laws</li> <li>Pi theorem of Buckingham</li> <li>Practical examples of hydraulic models</li> </ul> Strobl, Zunic: Wasserbau, Kap. 11 Hydraulische Modelle, Springer

Course L0812: Modelling of	Waves	
Тур	ject-/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	<ul> <li>Waves, interactions with shallow water and constructions</li> <li>Wave theories</li> <li>Sea state and surges</li> <li>Development of waves</li> <li>Wave spectra</li> <li>Modelling of Waves / phase averaged and phase resolved models</li> <li>Application of a phase averaged model for wave prediction (SWAN)</li> <li>Application of phase resolved wave models (Mike)</li> </ul>	
Literature	Vorlesungsumdruck	

Course L0810: Modelling of I	Flow in Rivers and Estuaries
Тур	Lecture
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Dr. Edgar Nehlsen, Prof. Peter Fröhle
Language	EN
Cycle	SoSe
Content	Introduction to numerical flow modelling
	<ul> <li>Processes affecting tht flow</li> <li>Examples and applications of numerical models</li> <li>Procedure of numerical modelling</li> <li>Model concept</li> </ul> Basic equations of hydrodynamics
	<ul> <li>Saint-Venant equations</li> <li>Euler Equations</li> <li>Navier-Stokes equations</li> <li>Reynolds-averaged Navier-Stokes equations</li> <li>Evaluation equations</li> </ul>
	<ul> <li>Shallow water equations</li> <li>Solving schemes <ul> <li>Numerical discretization</li> <li>Solution algorithms</li> <li>Convergence</li> </ul> </li> </ul>
Literature	Vorlesungsskript
	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).

Courses						
Title		Тур	Hrs/wk	СР		
Wastewater Systems - Collection, T		Lecture	2	2		
Wastewater Systems - Collection, T		Recitation Section (large)	1	1		
Advanced Wastewater Treatment ( Advanced Wastewater Treatment (		Lecture Recitation Section (large)	2 1	2 1		
Module Responsible	-	Rectation Section (large)	Ŧ	Ŧ		
Admission Requirements	None					
Recommended Previous		he key processes involved in wastewater treatr	nent			
Knowledge	Knowledge of wastewater management and t	The key processes involved in wastewater creati	nent.			
Educational Objectives	After taking part successfully, students have i	reached the following learning results				
Professional Competence	After taking part successionly, students have	leached the following learning results				
•	Chudente and able to autilize law and a fithe					
Knowledge		full range of treatment systems in waste water They can describe relevant economic, environ				
	dependence for sustainable water protection.	They can describe relevant economic, environ	nentai anu sociai	Tactors.		
Skills	Students are able to pre-design and explain	the available wastewater treatment processes	s and the scope o	of their application		
	municipal and for some industrial treatment p	nunicipal and for some industrial treatment plants.				
Personal Competence						
Social Competence	Social skills are not targeted in this module.					
Autonomy	Students are in a position to work on a sub	ject and to organize their work flow indepen	dently. They can	also present on th		
-	subject.			·		
Workload in Hours	Independent Study Time 96, Study Time in Le	ecture 84				
Course achievement	None					
Examination	Written exam					
Examination duration and	120 min					
scale						
Assignment for the						
Following Curricula	Civil Engineering: Specialisation Geotechnical					
	Civil Engineering: Specialisation Coastal Engir					
	Civil Engineering: Specialisation Water and Tr					
		neral Bioprocess Engineering: Elective Compuls	-			
		ialisation Environmental Engineering: Elective C	Compulsory			
	Environmental Engineering: Specialisation Wa					
		Specialisation II. Process Engineering and Bioted	••			
	International Management and Engineering: S	Specialisation II. Energy and Environmental Eng	-	Compulsory		
		ental Process Engineering: Elective Compulsory	1			
	Process Engineering: Specialisation Process E	ngineering: Elective Compulsory	,			
		ngineering: Elective Compulsory alisation Water: Compulsory				

Course L0934: Wastewater S	systems - Collection, Treatment and Reuse
Тур	Lecture
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
	<ul> <li>•Understanding the global situation with water and wastewater</li> <li>•Regional planning and decentralised systems</li> <li>•Overview on innovative approaches</li> <li>•In depth knowledge on advanced wastewater treatment options for different situations, for end-of-pipe and reuse</li> <li>•Mathematical Modelling of Nitrogen Removal</li> <li>•Exercises with calculations and design</li> </ul>
Literature	Henze, Mogens: Wastewater Treatment: Biological and Chemical Processes, Springer 2002, 430 pages George Tchobanoglous, Franklin L. Burton, H. David Stensel: Wastewater Engineering: Treatment and Reuse, Metcalf & Eddy McGraw-Hill, 2004 - 1819 pages

Course L0943: Wastewater Systems - Collection, Treatment and Reuse		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Ralf Otterpohl	
Language	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	
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

Courses	
<b>Fitle</b>	Typ Hrs/wk CP
City Planning (L1066)	Project-/problem-based Learning 4 6
•	Prof. Carsten Gertz
	None
Kecommended Previous Knowledge	for "Principles of Urban Planning": none
-	for "Designing Urban Streetscapes": some knowledge of transport planning, e.g. through taking the undergraduate class "Trans Planning and Traffic Engineering"
Educational Objectives	After taking part successfully, students have reached the following learning results
<b>Professional Competence</b>	
Knowledge	Students are able to:
	use technical terms of urban planning.
	describe the main determinants of urban development.
	<ul> <li>explain and compare different possibilities of how urban development can be influenced.</li> </ul>
	discuss requirements for public streetscapes.
	explain the importance of street design.
Skills	Students are able to:
	<ul> <li>read and analyze urban development concepts and designs for streetscapes</li> </ul>
	<ul> <li>appraise such concepts in the context of competing requirements.</li> </ul>
	<ul> <li>design, justify and reflect their own solutions for concrete examples.</li> </ul>
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:
	<ul> <li>independently complete a written report including drawings following a broadly pre-defined process.</li> </ul>
	<ul> <li>assess the consequences of their proposed solutions.</li> </ul>
	<ul> <li>independently acquire knowledge and apply this to new issues or problem areas.</li> </ul>
	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	
	Written elaboration
Examination duration and scale	written assignment, designwork during the semester
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
5	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 Water: Elective Compulsory
	Water and Environmental Engineering: Specialisation Environment: Elective 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:
	<ul> <li>legal framework,</li> <li>instruments and methods of planning,</li> <li>functional requirements,</li> <li>stakeholders and actors</li> <li>basic design requirements</li> <li>different planning levels and</li> <li>historical contexts.</li> </ul> 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 (2009) Stadtplanung: Eine illustrierte Einführung. Primus Verlag. Darmstadt. Frick, Dieter (2008) Theorie des Städtebaus: Zur baulich-räumlichen Organisation von Stadt. 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)		tation Section (small)	1	2
Project Development and Management (L1161) Le		ure ect-/problem-based Learning	1	1
Project Development and Managen		ct-/problem-based Learning	T	1
Module Responsible				
Admission Requirements Recommended Previous				
Kecommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, students have reached the following lea	arning recults		
	After taking part successiony, students have reached the following lea			
Professional Competence	Students can			
Kilowiedge				
	<ul> <li>give definitions of the main terms of construction logistics and provide the second sec</li></ul>	project development and m	anagement	
	<ul> <li>name advantages and disadvantages of internal or external cor</li> </ul>	nstruction logistics		
	<ul> <li>explain characteristics of products, demand and production of</li> </ul>	construction objects and the	eir consequer	nces for construction
	specific supply chains			
	<ul> <li>differentiate constructions logistics from other logistics systems</li> </ul>	5		
Skills	Students can			
	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			
	<ul> <li>design supply and waste removal concepts for a construction preserved.</li> </ul>	roject		
Personal Competence				
Social Competence				
	<ul> <li>hold precentations in and for groups</li> </ul>			
	<ul> <li>hold presentations in and for groups</li> <li>apply methods of conflict solving skills in group work and case solutions</li> </ul>	studios		
		scuules		
Autonomy	Students can			
	solve problems by holistic, systemic and flow oriented thinking			
	<ul> <li>solve problems by houside, systemic and now oriented tranking</li> <li>improve their creativity, negotiation skills, conflict and crises</li> </ul>	solution skills by applying	methods of	moderation in cas
	studies	solution skins by applying	includes of	
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	oulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Co			
	Civil Engineering: Specialisation Coastal Engineering: Elective Comput	•		
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsor			
	International Management and Engineering: Specialisation II. Civil Eng		ory	
	International Management and Engineering: Specialisation II. Logistics			
	Logistics, Infrastructure and Mobility: Specialisation Production and Lo	,		
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and	mobility: Elective Compulse	лу	

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	<ul> <li>The lecture gives deeper insight how important logistics are as a competetive factor for construction projects and which issues are to be adressed.</li> <li>The following toppics are covered: <ul> <li>competetive factor logistics</li> <li>the concept of systems, planning and coordination of logistics</li> <li>material, equipment and reverse logistics</li> <li>IT in construction logistics</li> <li>elements of the planning model of construction projects</li> <li>flow oriented logistics systems for construction projects</li> <li>logistics concepts for ready to use construction projects (especially procurement and waste removel logistics)</li> <li>best practice examples (construction logistics Potsdamer Platz, recent case study of the region)</li> </ul> </li> </ul>
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		
	<ul> <li>Advantages and disadvantages of different ways of project handling</li> </ul>		
	<ul> <li>organization, information, coordination and documentation</li> </ul>		
	cost and fincance management in projects		
	time- and capacity management in projects		
	<ul> <li>specific methods and instruments for successful team work</li> </ul>		
	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	urse 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. Uwe Starossek			
Admission Requirements	None			
<b>Recommended Previous</b>	Knowledge of linear structural analysis of	of statically determinate and indeterminate structu	ures; Mechanics	I/II, Mathematics
Knowledge	Differential equations I			
		and the state of the state of the state of the state of the		
	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge	After successful completion of this modu	ile, the student can explain the basic aspects of d	ynamic effects o	n structures and t
	respective methods.			
Skills	After successful completion of this more	dule, the students will be able to predict the res	ponse of materi	al and structures
	dynamics loading using the appropriate co	omputational approaches and methods.		
	.,			
Personal Competence				
Social Competence	Students can			
	<ul> <li>participate in subject-specific and in</li> </ul>			
	<ul> <li>defend their own work results in from</li> </ul>	ont of others		
	<ul> <li>promote the scientific development</li> </ul>	t of colleagues		
	Furthermore, they can give and acc	cept professional constructive criticism		
Autonomy		ne subject area from given and other sources and a		oblems. Furthermo
	they are able to structure the solution pro	ocess for problems in the area of Structural Analysis.		
Workload in Hours	Independent Study Time 96, Study Time i	n Lecture 84		
Credit points				
Course achievement				
	Written exam			
Examination duration and	150 min			
scale				
	Civil Engineering: Specialisation Structura	l Engineering: Compulsory		
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Compulsory			
-	Civil Engineering: Specialisation Geotechr	lical Engineering. Elective Compulsory		
Assignment for the Following Curricula		5 5 1 ,		
-	Civil Engineering: Specialisation Coastal E	ngineering: Elective Compulsory		
-	Civil Engineering: Specialisation Coastal E Civil Engineering: Specialisation Water an	ngineering: 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. Uwe Starossek
Language	DE
Cycle	SoSe
Content	<ul> <li>Single-degree-of-freedom systems: undamped and damped vibration, free vibration, forced vibrations due to harmonic, periodical or arbitrary loading, natural frequency, damping</li> <li>vibration isolation</li> <li>solution in the frequency-domain (Fourier transformation), solution in the time-domain</li> <li>multi-degree-of-freedom systems: continuous or discrete systems, modelling with finite elements, generalisation</li> <li>modal analysis</li> <li>power iteration according to v.Mises</li> <li>earthquake loading: seismological basics, response spectrum method</li> <li>wind-induced vibrations: engineering meteorology, aerodynamic, classification of excitation mechanisms</li> </ul>
Literature	Clough, R.W., Penzien, J.: Dynamics of Structures. 2. Aufl., McGraw-Hill, New York, 1993.

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. Uwe Starossek
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Тур	Lecture
Hrs/wk	
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Jürgen Priebe
Language	DE
Cycle	SoSe
Content	<ul> <li>basics of fatigue stress and fatigue resistance and determination of fatigue strength,</li> </ul>
	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,
	<ul> <li>set up of determination of fatigue strength in different examples,</li> </ul>
	<ul> <li>basics of construction and design regarding the problem of material fatigue,</li> </ul>
	<ul> <li>basics of linear elastic fracture mechanics under static and dynamic load,</li> </ul>
	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 1996
	Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993
	<ul> <li>DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsreg</li> <li>Bemessungsregeln f         ür den Hochbau; 1993</li> </ul>
	• 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 200

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				
<b>Fitle</b>		Тур	Hrs/wk	СР
Steel Construction Project (L1206)		Project Seminar	4	6
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
<b>Recommended Previous</b>	Steel and Composite Structures			
Knowledge				
Educational Objectives	After taking part successfully, students ha	ave 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 reacti			
	changing conditions resulting from other participants of the project.			
Personal Competence				
Social Competence	Students can present their results to othe	er 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 ind	ependently.		
Autonomy	Students can handle their part of the proj	ect on their own resposibility-		
Workload in Hours	Independent Study Time 124, Study Time	e 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 Geotechr	nical Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal E	Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Structura	al Engineering: Compulsory		

Course L1206: Steel Constru	ourse 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)		Recitation Section (large)	2	2
Steel Structures in Foundation and	Hydraulic Engineering (L1146)	Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>	complete modules: Geotechnics I-III, Mathema	itics I-III		
Knowledge	courses: Soil laboratory course			
Educational Objectives	After taking part successfully, students have r	eached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
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 Geotechnical	Engineering: Compulsory		
Following Curricula	la Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engin	eering: Compulsory		
	Theoretical Mechanical Engineering: Specialis	ation Maritime Technology: Elective Compulsory	1	
	Theoretical Mechanical Engineering: Technica	Complementary Course: Elective Compulsory		
	Water and Environmental Engineering: Specia	lisation Cities: Elective Compulsory		
	Water and Environmental Engineering: Specia	lisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Specia	lisation Water: Elective Compulsory		

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

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	urse 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)		Integrated Lecture	2 2	2 4
Smart Monitoring (L2763)	Duch Key Cucaudu	Recitation Section (small)	Z	4
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None		anian ana kalaful	
Kecommended Previous Knowledge	Basic knowledge or interest in object-oriented modeling, research and teaching areas, such as Internet of Things, skills of scientific working, are required. Basic knowledge	Industry 4.0 and cyber-physical sy	stems, as well a	
Educational Objectives	After taking part successfully, students have reached the	ollowing learning results		
Professional Competence				
	decentralized smart systems to be applied for continu- environment. In addition, the students will learn to design analysis techniques, modern software design concepts, ar also part of this module. In small groups, the studen "intelligent" sensors to be implemented by the studer techniques. The smart monitoring systems will be mount on scaled lab structures for validation purposes. The out module will "automatically" participate with their smart written papers and oral examinations form the final grade	and to implement intelligent sense id embedded computing methodolo ts will design smart monitoring s ts. Specific focus will be put on ed on real-world (built or natural) sy come of every group will be docum monitoring system in the annual	or systems using gies. Besides lect ystems that inte the application ystems, such as ented in a paper "Smart Monitorir	state-of-the-art d tures, project wor egrate a number of machine learn bridges or slopes, . All students of t ng" competition.
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written 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 Engineering	: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elec	tive Compulsory		
	Civil Engineering: Specialisation Structural Engineering: E			
	Civil Engineering: Specialisation Coastal Engineering: Elec	tive Compulsory		
	Civil Engineering: Specialisation Geotechnical Engineering	: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering: El			
	Civil Engineering: Specialisation Water and Traffic: Electiv			
	Environmental Engineering: Specialisation Waste and Ene			
	Environmental Engineering: Specialisation Biotechnology:			
	Environmental Engineering: Specialisation Water: Elective			
	Environmental Engineering: Specialisation Waste and Ene			
	Environmental Engineering: Specialisation Biotechnology:			
	Environmental Engineering: Specialisation Water: Elective			
	Water and Environmental Engineering: Specialisation Citie			
	Water and Environmental Engineering: Specialisation Citie			
	Water and Environmental Engineering: Specialisation Envi			
	Water and Environmental Engineering: Specialisation Envi	connent: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Wat	n Flactive Compulstry		

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	WiSe/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	

Course 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	WiSe/SoSe
Content	The contents of the exercises are based on the lecture contents. In addition to the exercises, project work will be conducted, 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.
Literature	

Courses				
Courses				
Title		Тур	Hrs/wk	СР
Water Protection and Wastewater I Water Protection and Wastewater I	5	Lecture Project Seminar	3	3 3
Module Responsible			-	-
Admission Requirements				
Recommended Previous				
Knowledge	Basic knowledge in water management;			
	Good knowledge in urban drainage;			
	Good knowledge of wastewater treat			
	Good knowledge of pollutants (e.g. Cl	JD, BOD, TS, N, P) and their properties;		
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	The students can describe the basic princip	es of the regulatory framework related to the	ne international and Eu	iropean water sect
	They can explain limnological processes, s	substance cycles and water morphology ir	n detail. They are able	e to assess comp
	problems related to water protection, such	as ecosystem service and wastewater tre	atment with a special	focus on innovat
	solutions, remediation measures as well as	conceptual approaches.		
Skills	Students can accurately assess current pro	blems and situations in a country-specific o	or local context. They c	can suggest concre
	actions to contribute to the planning of to			
	administrative and legislative solutions to so	blve these problems.		
Personal Competence	<b>-</b>			
Social Competence	The students can work together in internation	onal groups.		
Autonomy	Students are able to organize their work flo	w to prepare presentations and discussion	s. They can acquire ap	propriate knowled
	by making enquiries independently.			
	Independent Study Time 96, Study Time in I	Lecture 84		
Credit points				
Course achievement				
Examination	Presentation			
	Term paper plus presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structural E	ingineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnic	al Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Eng	ineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and	Traffic: Elective Compulsory		
	Environmental Engineering: Specialisation V	Vater: Elective Compulsory		
	International Management and Engineering:	Specialisation II. Civil Engineering: Elective	Compulsory	
	Joint European Master in Environmental Stu	dies - Cities and Sustainability: Specialisation	n Water: Elective Comp	oulsory
	Water and Environmental Engineering: Spec			
	Water and Environmental Engineering: Spec			
	Water and Environmental Engineering: Spec	ialisation 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	<ul> <li>The lecture focusses on:</li> <li>Regulatory Framework (e.g. WFD)</li> <li>Main instruments for the water management and protection</li> <li>In depth knowledge of relevant measures of water pollution control</li> <li>Urban drainage, treatment options in different regions on the world</li> <li>Rainwater management, improved management of heavy rainfalls, downpours, rainwater harvesting, rainwater infiltration</li> <li>Case Studies and Field Trips</li> </ul>
Literature	<ul> <li>The literature listed below is available in the library of the TUHH.</li> <li>Water and wastewater technology Hammer, M. J. 1., &amp; . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International.</li> <li>Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011) New York, NY: McGraw-Hill.</li> <li>Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ.</li> </ul>

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	al Condition and Damages (L0260)	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			
<b>Recommended Previous</b>	Basic knowledge about building materials or m	aterial science, for example by the mo	dule Building Ma	aterials and Build
Knowledge	Chemistry.			
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
<b>Professional Competence</b>				
Knowledge	The students are able to describe the rules for tr	ading, use and marking of construction pr	oducts in Germar	ny. They know whi
	methods for the testing of building material prope	rties are usable and know the limitations a	nd characterics o	f the most import
	testing methods.			
Chille	The students are able to responsibly discover the	allos for trading and using of building prod	usta in Cormony	
SKIIIS	The students are able to responsibly discover the i			tion of domograp
	They are able to chose suitable methods for the to			
	the examination of the structural conditions of bui are able to describe an examination in form of a t		nptons to the cau	se of damages. If
Personal Competence				
Social Competence	The students can describe the different roles of r	nanufacturers as well as testing, supervise	ory and certificati	on bodies within
	framework of material testing. They can describe t	he different roles of the participants in leg	al proceedings.	
Autonomy	The students are able to make the timing and the	operation steps to learn the specialist know	vledge of a very e	extensive field.
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Enginee	ering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engi	neering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering	ng: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory		
	International Management and Engineering: Speci	alisation II. Civil Engineering: Elective Com	oulsory	
	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		
CP	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		

Courses				
Title		Тур	Hrs/wk	СР
Subsoil and Underground Engineer	-	Lecture	2	2
Service Contract and Procurement	Law (L1906)	Lecture	2	2
Project Geotechnics (L0708)		Project-/problem-based Learning	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomv				
,	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
Course achievement				
Examination				
Examination duration and				
	30 11111			
scale				
-	Civil Engineering: Specialisation Coastal Engineering: Elective C			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elect			
	Civil Engineering: Specialisation Structural Engineering: Elective	1 5		
	Civil Engineering: Specialisation Water and Traffic: Elective Con	npulsory		

Course L0395: Subsoil and U	nderground Engineering Law
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Günther Schalk
Language	DE
Cycle	WiSe
Content	History of Civil Engineering Law (from 1700 BC to 2000 AD)
	• Basics of foundation and excarvation law / engineering law (the participants in the case law of geotechnical law case studies)
	Legal aspects of technical regulations in civil engineering (with case studies)
	• The civil engineering contract (including checklists for the special civil engineering contract design and execution)
	• The liability of the planner and entrepreneur in civil engineering (practical examples, jurisprudence and law, inter alia, to the Ordinance on Combatants, liability for defects and traffic safety obligations, construction law and insurance questions)
	• The ground / foundation risk and the systemic risk (also in the European context)
	The total debt in (low) building law (based on practice-oriented case constellations)
	• The (construction) conflict, the dispute avoidance models and the construction process (practice-oriented presentation)
Literature	Folienskript (in der Vorlesung erhältlich)
	weitere Literatur:
	Englert, Grauvogel und Maurer: Handbuch des Baugrund- und Tiefbaurechts. Werner-Verlag

Course L1906: Service Contr	ourse L1906: Service Contract and Procurement Law	
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Günther Schalk, Prof. Jürgen Grabe	
Language	DE	
Cycle	WiSe	
Content		
Literature		

## Module Manual M.Sc. "Civil Engineering"

Course L0708: Project Geote	urse L0708: Project Geotechnics		
Тур	Project-/problem-based Learning		
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	The students solve independently a project-based geotechnical problem in groups. Additional lectures concerning the problem will		
	be held and material will be distributed as study basis. Every two weeks the groups present their current project status. The final		
	work will be presentated in a final presentation.		
Literature	abhängig von der Fragestellung		

Courses						
Title				Тур	Hrs/wk	СР
Waste and Environmental Chemist Biological Waste Treatment (L0318				Practical Course	2 nina 3	2 4
-				Project-/problem-based Learn	ling 5	4
Module Responsible						
Admission Requirements						
	chemical and biological basic	CS				
Knowledge						
Educational Objectives	After taking part successfully	r, students have i	reached the followir	ig learning results		
Professional Competence						
Knowledge	The module aims possess kn	owledge concern	ing the planning of	biological waste treatment	plants. Students	are able to explain
	design and layout of anaerol	pic and aerobic w	aste treatment plar	ts in detail, describe differe	ent techniques for	r waste gas treatm
	plants for biological waste tr	eatment plants a	nd explain different	methods for waste analytic	S.	
Skills	The students are able to disc	cuss the compilat	ion of design and la	yout of plants. They can cr	itically evaluate t	echniques and qua
	control measurements. The	students can rec	herché and evaluat	e literature and date conne	ected to the tasks	s given in der mod
	and plan additional tests. Th	ey are capable of	f reflecting and eval	uating findings in the group	).	
Personal Competence						
	mpetence mpetence work results in front of others and promote the scientific development in front of colleagues. Furthermore, they ca			and defend their o		
Social competence						
	accept professional construct		the scientific deve	iophiene in none of coned	gues. Furthermor	c, they can give t
	accept professional construct					
Autonomu	Studente con independently	tan knowledge f	rom litoratura, buci	need or test reports and tr	anoform it to the	course projects T
Autonomy	Students can independently					
	are capable, in consultation				-	
	steps on this basis. Furthern			w application-or research-o	priented duties in	accordance with
	potential social, economic ar	iu cultural impaci	ι.			
Workload in Hours Credit points	Independent Study Time 110	), Study Time in L	Lecture 70			
Course achievement	Compulsory Bonus Form		Description			
course achievement		ct theoretical	and			
	-	ical work				
Examination	Presentation					
Examination duration and	Elaboration and Presentation	(15-25 minutes	in groups)			
scale		15 25 minutes	y. oup <i>s)</i>			
Assignment for the	Civil Engineering: Specialisat	ion Structural En	aineering: Elective	Compulsory		
Following Curricula						
i onowing curricula	Civil Engineering: Specialisat					
	Civil Engineering: Specialisat	•	•			
	5 5 1			2	Compulsory	
	Energy and Environmental E	• • •		antai Engineering: Elective (	compulsory	
	Environmental Engineering:			ray and Environmental Fra-	incoring, Elective	Compulsory
	International Management a	5 5	•	5,	5	1 5
	nome European Master in Env	nonmental Studi	es - ciues and Susta	ainability: Specialisation Energy	ergy: Elective COP	npulsory
	Water and Environmental En Water and Environmental En	gineering: Specia	alisation Cities: Elect	tive 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	DE/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	urse 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	<ol> <li>Introduction</li> <li>biological basics</li> <li>determination process specific material characterization</li> <li>aerobic degradation ( Composting, stabilization)</li> <li>anaerobic degradation (Biogas production, fermentation)</li> <li>Technical layout and process design</li> <li>Flue gas treatment</li> <li>Plant design practical phase</li> </ol>		
Literature			

Module M1716: Subs	urface Processes			
Courses				
Title		Тур	Hrs/wk	СР
Modeling of Subsurface Processes	L2730)	Lecture	2	2
Modeling of Subsurface Processes	L2731)	Recitation Section (small)	1	1
Modern Techniques for Subsurface		Lecture	2	2
Modern Techniques for Subsurface		Recitation Section (large)	1	1
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge				
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
	Independent Study Time 96, Study Time in Lec	ture 84		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Eng	ineering: Elective Compulsory		
-	Civil Engineering: Specialisation Geotechnical E			
-	Civil Engineering: Specialisation Coastal Engine	eering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Tra	• • •		
	Process Engineering: Specialisation Environme	ntal Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process En	gineering: Elective Compulsory		
	Water and Environmental Engineering: Special	isation Water: Compulsory		
	Water and Environmental Engineering: Speciali	isation Environment: Elective Compulsory		
	Water and Environmental Engineering: Special	isation Cities: Elective Compulsory		

Course L2730: Modeling of S	ourse L2730: Modeling of Subsurface Processes		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Dr. Alexandru Tatomir		
Language	EN		
Cycle	WiSe		
Content			
Literature			

Course L2731: Modeling of S	rse L2731: Modeling of Subsurface Processes			
Тур	Recitation Section (small)			
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			

Course L2728: Modern Techr	niques for 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	
Literature	

Course L2729: Modern Techr	urse L2729: Modern Techniques for 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		

Courses						
<b>Fitle</b>			Тур	Hrs/wk	СР	
Concrete Structures (L0579)			Seminar	1	1	
Structural Concrete Members (L05			Lecture	2	3	
Structural Concrete Members (L05			Recitation Section (large)	2	2	
Module Responsible		ch				
Admission Requirements	None					
<b>Recommended Previous</b>	Basics of structural a	analysis, conception and	d dimensioning of structural concrete			
Knowledge	Modules: Reinforced	Concrete Structures I+	II, Structural Analysis I+II, Mechanics I+II			
			··,			
Educational Objectives	After taking part suc	ccessfully, students hav	e reached the following learning results			
Professional Competence						
Knowledge	The students broaden their skills in structural engineering, especially in the field of buildings (houses, roofs, halls). They dispose					
2	the knowledge for the conception and design of concrete buildings and structural members that are often used.					
	_		-			
Skills	The students are able to apply procedures of the conception and dimensioning to to practical problems of structural enginee					
	They are capable t	o draft concrete buildi	ings and to design them for general action	effects and to plar	n their detailing	
	execution. Moreover	r, they can make design	and construction sketches and draw up techni	cal descriptions.		
Personal Competence						
-		le to obtain results of hi	gh guality in teamwork.			
	The students are able to obtain results of high quality in teamwork.					
Autonomy	The students are able to carry out complex conception and dimensioning tasks of structures under the guidance of tutors.					
	Independent Study 7	Independent Study Time 110, Study Time in Lecture 70				
Workload in Hours		· · · ·				
Workload in Hours Credit points	6					
		Form	Description			
Credit points		Form Presentation	Description Es werden 2 Referate ausgegeben			
Credit points	Compulsory Bonus Yes None					
Credit points Course achievement	Compulsory         Bonus           Yes         None           Written exam					
Credit points Course achievement Examination	Compulsory         Bonus           Yes         None           Written exam					
Credit points Course achievement Examination Examination duration and scale	Compulsory         Bonus           Yes         None           Written exam         120 minutes	Presentation				
Credit points Course achievement Examination Examination duration and scale	Compulsory         Bonus           Yes         None           Written exam         120 minutes           Civil Engineering: Space         Space	Presentation	Es werden 2 Referate ausgegeben			
Credit points Course achievement Examination Examination duration and scale Assignment for the	Compulsory         Bonus           Yes         None           Written exam         120 minutes           Civil Engineering: Sp.         Civil Engineering: Sp.	Presentation	Es werden 2 Referate ausgegeben			
Credit points Course achievement Examination Examination duration and scale Assignment for the	Compulsory         Bonus           Yes         None           Written exam         120 minutes           Civil Engineering: Sp Civil Engineering: Sp Civil Engineering: Sp	Presentation Decialisation Structural B Decialisation Geotechnic Decialisation Coastal Eng	Es werden 2 Referate ausgegeben			

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	Prof. Günter Rombach
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.

Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978	Course L0577: Structural Co	ncrete Members
CP 3         Workload in Hours         Independent Study Time 62, Study Time in Lecture 28         Lecturer         Prof. Günter Rombach         Laguage         DE         Cycle         Wise         Content         • skyscrapers: structural elements         • actions on structures         • bracing systems       • design off slabs (line and point supported plates and floor slabs)         • membranes and deep beams       • folded plates and shells         • trues models       • reinforced and prestressed members         • collch 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 200: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012         • Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formånderungen 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 1	Тур	Lecture
Workload in Hours         Independent Study Time 62, Study Time in Lecture 28           Lecturer         Prof. Günter Rombach           Language         DE           Cycle         WiSe           Content         • skyscrapers: structural elements           • actions on structrues         • bracing systems           • design off slabs (line and point supported plates and floor slabs)         • membranes and deep beams           • folded plates and shells         • truss models           • truss models         • 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: Erfauterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012           • Deutscher Ausschuss für Stahlbeton: Heft 600: Erfauterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012           • Deutscher Ausschuss für Stahlbeton: Heft 600: Erfauterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012           • Deutscher Ausschuss für Stahlbeton: Heft 600: Erfauterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012           • Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formändrerungen vor Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978           • Stiglalt, K., Wippel	Hrs/wk	2
Lecturer       Prof. Günter Rombach         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         • 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 2003         • 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, Betonkalender 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1973         • Schlaich J.; Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst & Sohn, Berlin, 1973	СР	3
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           • 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 2003           • Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005           • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DINEN 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, 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	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 2003           • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012           • 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, Betonkalender 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin, 1992           • Stiglat, K., Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst & Sohn, Berlin, 1998	Lecturer	Prof. Günter Rombach
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 aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003         • 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, Betonkalender 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1972         • Stiglat, K., Wippel: Platten. Verlag Ernst & Sohn, Berlin 1973         • Schlaich J.: Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst & Sohn, Berlin, 1978	Language	DE
<ul> <li>skyscrapers: structural elements</li> <li>actions on structures</li> <li>bracing systems</li> <li>design orf slabs (line and point supported plates and floor slabs)</li> <li>membranes and deep beams</li> <li>folded plates and shells</li> <li>truss models</li> <li>reinforced and prestressed members</li> </ul> Literature Vorlesungsunterlagen können im STUDiP heruntergeladen werden <ul> <li>Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010</li> <li>König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst &amp; Sohn, Berlin 2003</li> <li>Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 <ul> <li>Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012</li> <li>Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen vor Stahlbetontragwerken, Verlag Ernst &amp; Sohn, Berlin 1978</li> <li>Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst &amp; Sohn, Berlin 1992</li> <li>Stiglat, K., Wippel: Platten. Verlag Ernst &amp; Sohn, Berlin 1992</li> <li>Stiglat/Wippei: Platten. Verlag Ernst &amp; Sohn, Berlin 1973</li> <li>Schlaich J.; Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst &amp; Sohn, Berlin, 1973</li> </ul></li></ul>	Cycle	WiSe
	Content	<ul> <li>skyscrapers: structural elements <ul> <li>actions on structrues</li> <li>bracing systems</li> <li>design orf slabs (line and point supported plates and floor slabs)</li> <li>membranes and deep beams</li> <li>folded plates and shells</li> <li>truss models</li> <li>reinforced and prestressed members</li> </ul> </li> <li>Vorlesungsunterlagen können im STUDiP heruntergeladen werden</li> <li>Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010</li> <li>König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst &amp; Sohn, Berlin 2003</li> <li>Phocas, Marios C.: Hochhäuser aus Stahlbeton: Retonkalender 2003, Teil II, Seite 1-69, Verlag Ernst &amp; Sohn, Berlin 2003</li> <li>Phocas, Marios C.: Hochhäuser 1: Tragwerk und Konstruktiven Ingenieurbau. Springer, 1: Beuth Verlag, Berlin 2012</li> <li>Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken, Verlag Ernst &amp; Sohn, Berlin 1978</li> <li>Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst &amp; Sohn, Berlin 1992</li> <li>Stiglat/Wippel: Platten. Verlag Ernst &amp; Sohn, Berlin 1973</li> <li>Schlaich J.; Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst &amp; Sohn, Berlin, 1973</li> </ul>

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

Courses Title							
					T	Live (vile	СР
					Typ Lecture	Hrs/wk	3
Computational Analysis of Concrete Structures (L0598) Computational Analysis of Concrete Structures (L0599)				Recitation Section (large)	1	1	
E-Modeling of Concrete Structures							
Module Responsible	Prof. Günte	r Romba	ch				
Admission Requirements	None						
<b>Recommended Previous</b>	Basic knowledge in structural analysis and design of reinforced concrete structures (beams, slabs, shear walls).						).
Knowledge	Lectures '0	Concrete	Structures I und II'				
	Lectures 'S	Structural	Analysis I and II'				
	Lecture 'Concrete Structures'						
Educational Objectives	After taking part successfully, students have reached the following learning results						
<b>Professional Competence</b>							
Knowledge	The students know the problems of numerical modeling and design of an arbitrary concrete structure.						
Skills	The studen	ts can mo	odel and design an arb	itrary concrete structu	re by means of a finite element	software pack	kage.
Personal Competence							
Social Competence	The students can model and design in teamwork a real concrete structure by means of a finite element software package.						
Autonomy	The students can model and design a real concrete structure based on a finite element software package and discuss the p and results with other students.					discuss the proble	
-							
		nt Study 1	Time 110, Study Time i	in Lecture 70			
	6						
course achievement	Course achievement         Compulsory         Bonus         Form         Description           Yes         None         Excercises         Es ist ein Tragsystem mit TEDDY zu modellieren				on		
				-	•		ochonprogramm
	Yes None Attestation Am Ende des Semster ist ein Tragsystem mit dem Rech modellieren					echenprogramm 2	
Examination							
Examination duration and	45 min						
scale							
Assignment for the	Civil Engine	eering: Sp	ecialisation Structural	Engineering: Elective (	Compulsory		
Following Curricula	-	• •					
-	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory						

Course L0598: Computationa	I Analysis of Concrete Structures
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Content	<ul> <li>Modeling of beam and truss structures <ul> <li>Discontinuity regions, like frame corners, openings, shear walls with large openings</li> <li>Bracing of high-rise buildings</li> <li>Modeling of bridges</li> <li>Nonlinear analysis</li> </ul> </li> <li>Finite-Elemente-analysis of slabs: support conditions, singularity regions</li> <li>Finite-Elemente-Berechnungen of shear walls and deep beams: support condition, design</li> <li>Coupled systems</li> <li>Modeling of slab supported on beams</li> <li>Shell structures</li> <li>3D building models</li> <li>Nonlinear analysis of slabs and shells</li> <li>Documentation</li> </ul>
Literature	<ul> <li>Vorlesungsumdruck</li> <li>Rombach, G.A. (2007): Anwendung der Finite-Elemente-Methode im Betonbau. 2. Auflage, Verlag Ernst &amp; Sohn, Berlin</li> <li>Rombach G.A. (2011): Finite-Element Design of Concrete Structures, 2nd edition, ICE publishing</li> <li>Hartmann, F., Katz, C. (2002): Statik mit finiten Elementen. Springer, Berlin</li> </ul>

Course L0599: Computationa	Irse L0599: Computational Analysis of Concrete Structures		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Günter Rombach		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L0600: FE-Modeling of	of Concrete Structures
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Lukas Henze
Language	DE
Cycle	WiSe
Content	Finite Element Modeling and computational design of concrete structures by 'SOFiSTiK'
Literature	<ul> <li>Rombach G.: Anwendung der Finite - Elemente - Methode im Betonbau. 2. Auflage. Verlag Ernst &amp;.Sohn, Berlin, 2007</li> <li>Rombach G.: Finite-Element Design of Concrete Structures. 2nd edition, ICE Publishing, London, 2011, ISBN 0 7277 32749</li> <li>Rombach G.: EDV-unterstützte Berechnungen im Stahlbetonbau. in: "Stahlbetonbau aktuell 2014" (ed. Gorris A., Hegger J., Mark P.), Berlin 2014 (S. C1C.36)</li> </ul>

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		Lecture	2	2			
Water Resource Management (L04)		Recitation Section (small)	1	1			
Module Responsible							
Admission Requirements	None						
	Knowledge of water management and the	e key processes involved in water treatment.					
Knowledge							
-	After taking part successfully, students ha	ave reached the following learning results					
Professional Competence		is of conflict in water management, as well as					
Skills	water supply. They will understand relevant economic, environmental and social factors. Students will be able to explain a outline the organisational structures of water companies. They will be able to explain the available water treatment processes the scope of their application. Students will be able to assess complex problems in drinking water production and establish solutions involving water						
	management and technical measures. They will be able to assess the evaluation methods that can be used for this. Stude be able to carry out chemical calculations for selected treatment processes and apply generally accepted technical ru standards to these processes.						
Personal Competence							
	Working in a diverse group of specialists, students will be able to develop and document complex solutions for the management 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 joint solutions in teams of diverse experts and present these solutions to others. 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	None						
Examination	Written exam						
Examination duration and							
scale	· · · ·						
Assignment for the	e Civil Engineering: Specialisation Structural Engineering: Elective Compulsory						
Following Curricula							
	Civil Engineering: Specialisation Water and Traffic: Compulsory						
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory						
	Energy and Environmental Engineering: Specialisation Energy and Environmental Engineering: Elective Compulsory						
	International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory						
	Water and Environmental Engineering: Specialisation Water: Compulsory						
	Water and Environmental Engineering: Sp	pecialisation Environment: Elective Compulsory					
	Water and Environmental Engineering: Sp						

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	<ul> <li>MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John Wiley &amp; Sons, Hoboken, 2005.</li> <li>Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley &amp; Sons, New York, 1996.</li> <li>DVGW (Hrsg.): Wasseraufbereitung - Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004.</li> <li>Jensen, J. N.: A Problem Solving Approach to Aquatic Chemistry. John Wiley &amp; Sons, Inc., New York, 2003.</li> </ul>

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
	<ul> <li>overview:</li> <li>Current situation of global water resources</li> <li>User and Stakeholder conflicts</li> <li>Wasserressourcenmanagement in urbane Gebieten</li> <li>Rechtliche Aspekte, Organisationsformen Trinkwasserversorgungsunternehmen.</li> <li>Ökobilanzierung, Benchmarking in der Wasserversorgung</li> </ul>
Literature	<ul> <li>Aktuelle UN World Water Development Reports</li> <li>Branchenbild der deutschen Wasserwirtschaft, VKU (2011)</li> <li>Aktuelle Artikel wissenschaftlicher Zeitschriften</li> <li>Ppt der Vorlesung</li> </ul>

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	

2				
Courses				
Title	(11069) Pr		Hrs/wk 4	<b>CP</b> 6
Integrated Transportation Planning		oject-/problem-based Learning	4	0
Module Responsible				
Admission Requirements			la national and To	
Recommended Previous Knowledge	some knowledge of transport planning, e.g. through taking the unde	argraduate class "Transport Pi	anning and Tr	anic Engineerin
-	After taking part successfully, students have reached the following l	learning results		
Professional Competence	Alter taking part successionly, students have reached the following i			
	Students are able to:			
	describe interdependencies between land-use/location choice     available and evolute the social esclarised and escenario offer			
	<ul> <li>explain and evaluate the social, ecological and economic effe</li> <li>relate current issues in the area of integrated transport plann</li> </ul>			es.
			on them.	
Skills	Students are able to:			
	quantify important parameters, which influence travel demar			
	<ul> <li>comprehensively examine a pre-defined or self-selected topi</li> </ul>	c from a transportation studi	es perspective	and document t
	results in accordance with scientific conventions.			
Demonstration of the second se				
Personal Competence	Students are able to:			
Social competence				
	<ul> <li>provide feedback on topical contents and their teaching.</li> </ul>			
	<ul> <li>constructively handle feedback on their own work.</li> </ul>			
	<ul> <li>produce results in group work and document these.</li> </ul>			
Autonomy	Students are able to:			
	- access notantial concernances of their future professional ac	tivition		
	<ul> <li>assess potential consequences of their future professional ac</li> <li>independently plan working on a pre-defined project topic, ac</li> </ul>		de and use ar	propriate means f
	its execution.	equire the necessary knowled	ge and use ap	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
	written assignment with presentation during the semester			
scale				
-	Civil Engineering: Specialisation Structural Engineering: Elective Con Civil Engineering: Specialisation Geotechnical Engineering: Elective			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Civil Engineering: Specialisation Coastal Engineering: Elective Comp	, ,		
	Civil Engineering: Specialisation Coastal Engineering: Elective Comp Civil Engineering: Specialisation Water and Traffic: Compulsory			
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure a	nd Mobility: Elective Compuls	ory	
	Water and Environmental Engineering: Specialisation Water: Electiv			
	Water and Environmental Engineering: Specialisation Environment:			
	Water and Environmental Engineering: Specialisation Cities: Compu			

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 (2005) Entwicklung innovativer Verkehrsstrategien für die mobile Gesellschaft. Erich Schmidt Verlag. Berlin. Bracher, Tilman u. a. (Hrsg.) (68. Ergänzung 2013) 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			
<b>Recommended Previous</b>	Basics of steel construction (i.e. Steel Structures I and II, BUBC)	)		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	After successful completition, students can			
	describe the phenomenon of local buckling			
	explain warping torsion			
	<ul> <li>illustrate the behaviour of composite structures</li> </ul>			
	<ul> <li>specify the principles in design of composite structures</li> </ul>			
	<ul> <li>sketch the contructions of steel and composite bridges</li> </ul>			
Skills	After successful participation students are able to			
	check stiffened and unstiffened plated structures			
	<ul> <li>recognize and verify warping tosion in strucures</li> </ul>			
	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			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Compu	llsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elec	ctive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective C	Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Con	npulsory		
	International Management and Engineering: Specialisation II. Ci	ivil Engineering: Elective Com	oulsory	

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	<ul> <li>Local-buckling of plated structures</li> <li>Warping torsion</li> <li>Composite-girders, -columns, -slabs, -bridges</li> <li>Principles in composite constructions</li> <li>Bridge-design and -construction</li> </ul>	
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		
Lecturer		
Language		
Cycle	Lecture Contents ,Steel Bridge Construction'	
content	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	
	<ul> <li>Ahlgrimm, J., Lohrer, I.: Erneuerung der Eisenbahnüberführung in Fulda-Horas über die Fulda, Stahlbau 74 (2005), Heft 2, S.</li> <li>114</li> </ul>	

Courses Title Ergonomics (L0653) Analysis of Offshore Structures (L1867 Excellence in International Project Deli Design of Prefabricated Concrete Struc	very (L2387) tures (L0596)	<b>Typ</b> Lecture Lecture	Hrs/wk	СР
Ergonomics (L0653) Analysis of Offshore Structures (L1867 Excellence in International Project Deli Design of Prefabricated Concrete Struc	very (L2387) tures (L0596)	Lecture		CP
Analysis of Offshore Structures (L1867 Excellence in International Project Deli Design of Prefabricated Concrete Struc	very (L2387) tures (L0596)		2	•••
Excellence in International Project Deli Design of Prefabricated Concrete Strue	very (L2387) tures (L0596)	Lecture	Z	3
Design of Prefabricated Concrete Strue	tures (L0596)		1	1
-		Integrated Lecture	2	2
	turoc (10507)	Lecture	1	1
Design of Prefabricated Concrete Strue	luies (LUJ97)	Recitation Section (large)	1	1
Forum I - Geotechnics and Constructio	n Management (L1634)	Seminar	1	1
Forum II - Geotechnics and Construction	n Management (L1635)	Seminar	1	1
Geotechnical Engineering Design (L24	17)	Lecture	2	3
Timber Structures (L1151)		Seminar	2	2
Innovative Timber Construction (L266	)	Lecture	2	3
Glass Structures (L1152)		Lecture	2	2
Glass Structures (L1447)		Recitation Section (large)	1	1
Testing and non-destructive examinat	on of concrete members (L2725)	Project-/problem-based Learning	2	2
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 Pr	of. Frank Schmidt-Döhl			
Admission Requirements No	ne			
Recommended Previous no	ne			
Knowledge				
Educational Objectives Af	er taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	<ul> <li>Students are able to find their way through selected special areas within civil and structural engineering.</li> <li>Students are able to explain basic models and procedures in selected special areas of civil and structural engineering.</li> <li>Students are able to interrelate scientific and technical knowledge.</li> </ul>			
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 courses.	s they want to deepen their knowledge	and skills thr	ough the election o
Workload in Hours De	Depends on choice of courses			
Credit points 6				
Assignment for the Ci	/il Engineering: Specialisation Structural Engineering: E	lective Compulsory		
Following Curricula Ci	/il Engineering: Specialisation Geotechnical Engineerin	g: Elective Compulsory		
-	/il Engineering: Specialisation Coastal Engineering: Ele			
	/il Engineering: Specialisation Water and Traffic: Electiv			

Course L0653: Ergonomics	ourse L0653: Eraonomics	
	Lecture	
Hrs/wk		
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Mündliche Prüfung	
Examination duration and	30 min	
scale		
Lecturer	Dr. Armin Bossemeyer	
Language	DE	
Cycle	WiSe	
Content		
Literature		

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Тур	Lecture
Hrs/wk	
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 L2387: Excellence in	Course L2387: Excellence in International Project Delivery	
Тур	Integrated Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	laut FSPO	
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt	
scale		
Lecturer	Dr. Jens Huckfeldt	
Language	EN	
Cycle	SoSe	
Content		
Literature		

Course L0596: Design of Pre	fabricated Concrete Structures
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and	60 min
scale	
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	<ul> <li>application and advantages and disadvantages of precast concrete structures</li> <li>basics of design - precast element production - construction - tolerances</li> <li>elements of a warehouse</li> <li>design of a beam - joints</li> <li>design of D-regions: half joints, corbels, openings</li> <li>slab types - walls - facades</li> <li>footings: pocket and block foundations</li> <li>joints - connections</li> <li>shear design of the interface between concrete cast at different times</li> <li>unreinforced concrete structures</li> </ul>
Literature	<ul> <li>Bachmann H., Steinle A.; Hahn V.: Bauen mit Betonfertigteilen. Betonkalender 2009, Teil I, Verlag Ernst &amp; Sohn, Berlin</li> <li>Bindseil P.: Stahlbetonfertigteile. Werner Verlag, 1998</li> <li>FIP: FIP Handbuch für Planung und Entwerfen von Fertigteilbauten (siehe Zeitschrift: Beton- und Fertigteiltechnik ab 3/1996)</li> <li>Bergmeister K.: Konstruieren von Fertigteilen. Betonkalender 2005 Teil 2, S. 163-240</li> <li>Reineck KH.: Modellierung der D-Bereiche von Fertigteilen. Betonkalender 2005 Teil 2, S. 241-296</li> <li>Graubner CA. et. al.: Bemessung von Fertigteilen nach DIN 1045-1. Betonkalender 2005 Teil 2, S. 297-374</li> </ul> Broschüren der Fachvereinigung Deutscher Betonfertigteilbau e.V. siehe: www.fdb-fertigteilbau.de <ul> <li>www.systembauweise.de</li> </ul>

Course L0597: Design of Pre	Course L0597: Design of Prefabricated Concrete Structures	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Examination Form	Klausur	
Examination duration and	Siehe korrespondierende Vorlesung	
scale		
Lecturer	Prof. Günter Rombach	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1634: Forum I - Geo	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	ourse 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 L2447: Geotechnical	Engineering Design
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and	45 Min.
scale	
Lecturer	Prof. Jürgen Grabe, Dr. Tim Pucker
Language	DE
Cycle	WiSe
Content	The focus of the course is on the design of geotechnical structures. Methods and fundamental approaches for the successful processing of geotechnical designs are taught. Theoretical approaches are backed up with examples from everyday work in industry. In parallel to the theoretical content, students are given a practical task for a geotechnical design at beginning of the course, which will be worked on in small teams. In addition to the application of the already acquired technical knowledge, topics like realisation, construction sequence planning, cost calculation, optimisation and evaluation criteria are also part of the course. The event will be finished with the presentation of the designs.
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
CP	3
Workload in Hours	Independent Study Time 62, 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 L2725: Testing and non-destructive examination of concrete members	
Тур	Project-/problem-based Learning
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	Prof. Günter Rombach, Dr. Lukas Henze
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	laut FSPO
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	laut FSPO
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	laut FSPO
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.

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Course L2789: Structural Design		
	Seminar	
Hrs/wk		
CP		
-	- Independent Study Time 32, Study Time in Lecture 28	
Examination Form		
Examination duration and		
scale		
Lecturer	Dr. Jan Mittelstädt	
Language	DE/EN	
Cycle		
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	
<b>Recommended Previous</b>	Subjects of the Foundation Engineering specialisation.	
Knowledge		
Educational Objectives	After taking part successfully, students have reached the following learning results	
<b>Professional Competence</b>		
Knowledge	The students are able to demonstrate their detailed knowledge in the field of geotechnical and foundation engineering. They c exemplify the state of technology and application and discuss critically in the context of actual problems and general conditions science and society.	
	The students can develop solving strategies and approaches for fundamental and practical problems in geotechnical ar foundation engineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and econom 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 these methods relate to the field of work and how the context of application has 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 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 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	
Assignment for the	Civil Engineering: Specialisation Geotechnical Engineering: Compulsory	
Following Curricula		

Courses				
Title		Тур	Hrs/wk	СР
Plates and Shells (L1199)		Lecture	2	2
Nonlinear Analysis of Frame Struct		Lecture	2	2
Nonlinear Analysis of Frame Struct	ure (L1201)	Recitation Section (large)	2	2
Module Responsible	Prof. Uwe Starossek			
Admission Requirements	None			
Recommended Previous Knowledge	Mechanics I/II, Mathematics I/II, Differer	itial Equations I		
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	After successful completion of this mod	ule, students can explain selected elements of high	er structural analys	is.
Skills	After successful completion of this mo methods of advanced structural analysi	dule, the students are able to assess the premise s. They are able to use these methods for performin		
Personal Competence				
Social Competence	Students can			
	<ul> <li>participate in subject-specific and</li> </ul>	d interdisciplinary discussions.		
	<ul> <li>defend their own work results in</li> </ul>			
	promote the scientific developme			
	<ul> <li>Furthermore, they can give and a</li> </ul>	accept professional constructive criticism		
Autonomy	The students have the opportunity to ve	pluntarily and independently work homework proble	ms.	
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 scale	135 min			
Assignment for the	Civil Engineering: Specialisation Structu	ral Engineering: Elective Compulsory		
Following Curricula		hnical Engineering: Elective Compulsory		
. enering carrieura	operation debted			

Trees	Lecture	
Hrs/wk		
CP		
	Independent Study Time 32, Study Time in Lecture 28	
	Dr. Jürgen Priebe	
Language		
	WiSe	
Content	Theory of plates loaded in-plane	
	<ul> <li>Governing equations (equilibrium, kinematics, constitutive law)</li> </ul>	
	Differential equation	
	Airy stress function	
	Plane stress / plane strain	
	Structural behaviour of plates loaded in-plane	
	Theory of plates in bending	
	Governing equations (equilibrium, kinematics, constitutive law)	
	Differential equation	
	Navier solution / Fourier series expansion	
	Approximation procedures	
	Structural behaviour of plates in bending	
	Shell theory	
	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	
	Stability problems (overview)	
	Plate buckling	
	Shell buckling	
Literature	Basar, Y.: Krätzig, W.B. (1985): Mechanik der Flächentragwerke. Vieweg-Verlag, Braunschweig, Wiesbaden	
	<ul> <li>Basar, T., Kralzig, W.B. (1983). Mechanik der Plachendragwerke. Vieweg-Verlag, Brauhschweig, Wiesbaden</li> <li>Girkmann, K. (1963): Flächentragwerke, Springer Verlag, Wien, 1963, unveränderter Nachdruck 1986</li> </ul>	
	<ul> <li>Zienkiewicz, O.C. (1977): The Finite Element Method in Enginieering Science. McGraw-Hill, London</li> </ul>	

Course L1200: Nonlinear Ana	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	WiSe
Content	-Types of nonlinearity
	-relevance of nonlinear effects on structural analysis
	-comparison and classification of 1 <sup>st</sup> order theory, 2 <sup>nd</sup> order theory and 3 <sup>rd</sup> order theory with regard to the coverage of geometric nonlinearity
	-fundamentals of 2 <sup>nd</sup> order elasticity theory for frame structures
	-application of 2 <sup>nd</sup> order elasticity theory using finite elements: common displacement method
	-fundamentals of analytical application of 2 <sup>nd</sup> order elasticity theory: derivation and solution of differential equation
	-structurally applied methods of analytical application of 2 <sup>nd</sup> order elasticity theory: common displacement method using analytical stiffness matrix, slope-deflection method for sway and non-sway frame structures, consideration of imperfections
	1 <sup>st</sup> order plastic hinge theory
Literature	Rothert, H.; Gensichen, V. (1987): Nichtlineare Stabstatik. Springer Verlag, Berlin

ourse L1201: Nonlinear Analysis of Frame Structure	
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Courses	
Title Adaptation to climate change in hy	rdraulic engineering (L2291) Project-/problem-based Learning 4 6
Module Responsible	Prof. Peter Fröhle
Admission Requirements	None
Recommended Previous Knowledge	Hydrology Hydraulic Engineering
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence Knowledge Skills	<ul> <li>Climate protection and climate adaptation</li> <li>Insights into climate change and its regional characteristics - fundamentals, climate modelling / climate models</li> <li>Impacts of climate change on the components of the regional hydrological cycle</li> <li>Fundamentals of analysis of climate data</li> <li>Consequences of the impact of the climate change</li> <li>Measures for climate adaptation</li> <li>Assessment, prioritization and communication of adaptation measures</li> <li>Fundamentals of the analysis of hydrometeorological and hydrological data</li> </ul>
Personal Competence Social Competence Autonomy	<ul> <li>Working in heterogenous groups</li> <li>Working with different scientific / non-scientific disciplines</li> <li>Self reflection</li> </ul>
	Autonomous work on complex tasks
West-teed in 11	Independent Study Time 124, Study Time in Lecture 56
	Independent Study Time 124, Study Time in Lecture 56
Credit points Course achievement	
Examination	
	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	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	<ul> <li>Climate protection and climate adaptation</li> <li>Findings on climate change and its regional characteristics: fundamentals of climate change, climate modelling / climate models</li> <li>Impacts of climate change on the components of the regional hydrological cycle(climate science view)</li> <li>Fundamentals of the analysis of climate data</li> <li>Concequences of the impacts of climate change (ingenieering science view)</li> <li>Measures for climate change adaptation</li> <li>Assessment, prioritization and communication of measures</li> <li>Fundamentals of analysis of hydrometeorological and hydrological data</li> </ul>
Literature	Bereitgestellte eLearning Plattform

Courses					
Title		Тур	Hrs/wk	СР	
Scientific Working in Computationa	l Engineering (L2764)	Project-/problem-based Learning	4	6	
Module Responsible	Prof. Kay Smarsly				
Admission Requirements	None				
<b>Recommended Previous</b>	Basic knowledge in scientific writing. String inte	erest in topics related to computing in civil engined	ering.		
Knowledge					
Educational Objectives	After taking part successfully, students have re	ached the following learning results			
Professional Competence					
	thinking, being able to accurately plan, implement and analyze scientific projects, such as prospective master theses. S scientific writing is of particular importance in this course, a scientific paper will be developed, which is a prerequisite for the texamination. The paper will be written based on a project to be conducted within this course. Project meetings in small gro presentations, and critical discussions of scientific publications are further key activities.				
Skills					
Personal Competence					
Social Competence					
Autonomy					
	Independent Study Time 124, Study Time in Le	cture 56			
Credit points					
Course achievement					
	Written elaboration				
	10 pages of work with 15-minute oral presenta	tion			
scale					
	Civil Engineering: Specialisation Water and Tra	ffic: Elective Compulsory			
Assignment for the					
Assignment for the	Civil Engineering: Specialisation Geotechnical E Civil Engineering: Specialisation Coastal Engine	Engineering: 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					

## **Specialization Structural Engineering**

## Module M1437: Non destructive testing of materials and parts Courses Title Тур Hrs/wk СР Non destructive testing of materials and parts (L2215) Lecture 2 2 3 Non destructive testing of materials and parts (L2217) Project-/problem-based Learning 3 Non destructive testing of materials and parts (L2216) Recitation Section (large) 1 1 Module Responsible Prof. Bodo Fiedler **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 96, Study Time in Lecture 84 Credit points 6 **Course achievement** None Examination Written elaboration Examination duration and Written document about theory and praxis scale Assignment for the Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Following Curricula Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Materials Science: Specialisation Engineering Materials: Elective Compulsory

Course L2215: Non destructi	ve testing of materials and parts
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Robert Meißner, Prof. Marcus Rutner
Language	DE/EN
Cycle	WiSe
Content	This strongly interdisciplinary lecture and practical course is offered to Masterstudents who are interesed to learn about an important field across engineering and material science industries, i.e. nondestructive testing of materials and parts. Interdisciplinary approaches and thinking becomes more and more important since many problems extend into various disciplines, hence, can only be solved through interdisciplinary thinking and collaboration. Accordingly, this module combines the efforts of 4 different disciplines, i.e. mechanical engineering, civil engineering, materials science and computer science with a touch of electrical engineering. Nondestructive testing (NDT) is the process of inspecting, testing, and evaluating materials, parts, and assemblies to understand properties and defects without causing damage to the material or part. This scientific approach enables to make intrinsic material and component characteristics visible. Hence, the approach links detection approaches (e.g. linear and nonlinear acoustic methods, ultrasonic testing, Magnetic Particle Testing, thermo-chemical methods, etc.) with material physics and the mechanics of components, further, with evaluation, interpretation, big data management, transmission of data, and cybersecurity. The module embraces a lecture and a practical course. Contents of the lecture are NTD technologies and their theory behind, evaluation, transmission of data, while the students will apply the NDT technologies during the practical course in the experimental test halls and labs at TUHH. Lecture and practical course split into the major themes: A) Detection: Theory and Practice B) Evaluation of Data: Theory and Practice C) Data Acquisition and Transmission with Wireless, Batteryless Sensor
	Devices:Theory and Practice
Literature	

Course L2217: Non destructi	urse L2217: Non destructive testing of materials and parts		
Тур	Project-/problem-based Learning		
Hrs/wk	3		
СР	3		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Robert Meißner, Prof. Marcus Rutner		
Language	DE/EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L2216: Non destructiv	ve testing of materials and parts
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Robert Meißner, Prof. Marcus Rutner
Language	DE/EN
Cycle	WiSe
Content	This strongly interdisciplinary lecture and practical course is offered to Masterstudents who are interesed to learn about an
	important field across engineering and material science industries, i.e. nondestructive testing of materials and parts. Interdisciplinary approaches and thinking becomes more and more important since many problems extend into various disciplines, hence, can only be solved through interdisciplinary thinking and collaboration. Accordingly, this module combines the efforts of 4 different disciplines, i.e. mechanical engineering, civil engineering, materials science and computer science with a touch of electrical engineering. Nondestructive testing (NDT) is the process of inspecting, testing, and evaluating materials, parts, and assemblies to understand properties and defects without causing damage to the material or part. This scientific approach enables to make intrinsic material and component characteristics visible. Hence, the approach links detection approaches (e.g. linear and nonlinear acoustic methods, ultrasonic testing, Magnetic Particle Testing, thermo-chemical methods, etc.) with material physics and the mechanics of components, further, with evaluation, interpretation, big data management, transmission of data, and cybersecurity. The module embraces a lecture and a practical course. Contents of the lecture are NTD technologies and their theory behind, evaluation, transmission of data, while the students will apply the NDT technologies during the practical course in the experimental test halls and labs at TUHH. Lecture and practical course split into the major themes: A) Detection: Theory and Practice B) Evaluation of Data: Theory and Practice C) Data Acquisition and Transmission with Wireless, Batteryless Sensor Devices:Theory and Practice
Literature	

Courses						
<b>Fitle</b>		Тур	Hrs/wk	СР		
Numerical Methods in Geotechnics		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					
<b>Recommended Previous</b>						
Knowledge						
Educational Objectives	After taking part successfully, students have	reached the following learning results				
Professional Competence						
Knowledge						
Skills						
Personal Competence						
Social Competence						
Autonomy						
	Independent Study Time 96, Study Time in L	ecture 84				
Credit points						
Course achievement						
	Written exam					
Examination duration and						
scale						
Assignment for the	Civil Engineering: Specialisation Structural E	ngineering: Compulsory				
•	Civil Engineering: Specialisation Geotechnical Engineering: Compulsory					
	Civil Engineering: Specialisation Coastal Eng					
	Civil Engineering: Specialisation Water and T					
	5 5 1	Specialisation II. Civil Engineering: Elective Comp	ulcon.			

Course L0375: Numerical Me	thods 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:
	<ul> <li>numerical simulations</li> <li>numerical algorithms</li> <li>finite element method</li> <li>application of finite element method in geomechanics</li> <li>constitutive models for soils</li> <li>contact models for soil structure interaction</li> <li>selected applications</li> </ul>
Literature	<ul> <li>Wriggers P. (2001): Nichtlineare Finite-Elemente-Methoden, Springer Verlag, Berlin</li> <li>Bathe Klaus-Jürgen (2002): Finite-Elemente-Methoden. Springer Verlag, Berlin</li> </ul>

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

Course L0498: Advanced Foundation Engineering					
Тур	Recitation Section (large)				
Hrs/wk	1				
СР	1				
Workload in Hours	ent 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			т	ур	Hrs/wk	СР
Concrete Structures (L0579)			S	eminar	1	1
Structural Concrete Members (L05	77)		L	ecture	2	3
Structural Concrete Members (L05	78)		R	ecitation Section (large)	2	2
Module Responsible	Prof. Günter Romba	ach				
Admission Requirements	None					
<b>Recommended Previous</b>	Basics of structural	analysis, conception ar	nd dimensioning of struc	tural concrete		
Knowledge	Madulas: Painfarca	d Concroto Structuros I	+II, Structural Analysis I-	III Mochanics IIII		
	Modules. Reinforce		Th, Scructurul Analysis i			
Educational Objectives	After taking part su	iccessfully, students ha	ve reached the following	learning results		
Professional Competence						
Knowledge	The students broad	len their skills in structu	ural engineering, especia	lly in the field of buildings	(houses, roofs, h	alls). They dispos
	the knowledge for t	the conception and desi	ign of concrete buildings	and structural members t	hat are often used	d.
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 plan their detailing and					
	execution. Moreover, they can make design and construction sketches and draw up technical descriptions.					
Personal Competence						
		hle to obtain results of t	nigh quality in teamwork			
Social competence	The students are at		light quality in teamwork	•		
Autonomy	The students are al	ble to carry out complex	x conception and dimens	ioning tasks of structures	under the guidan	ce of tutors.
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70					
Credit points		Time 110, Study Time				
Course achievement		Form	Description			
	Yes None	Presentation	Es werden 2 Re	ferate ausgegeben		
Examination	Written exam					
Examination duration and	120 minutes					
scale						
Assignment for the	Civil Engineering: S	pecialisation Structural	Engineering: Compulsor	y		
	Civil Engineering: S	pecialisation Geotechni	ical Engineering: Elective	e Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory					
Following Curricula	Civil Engineering: S	opecialisation Coastal Er	naineerina: Elective Com	pulsorv		
Following Curricula		•	ngineering: Elective Com d Traffic: Elective Compu			

Course L0579: Concrete Structures		
Тур	Seminar	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Günter Rombach	
Language	DE	
Cycle	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.	

Typ       Lecture         Hrsivk 2	Course L0577: Structural Co	ncrete Members
CP       3         Workload in Hours       Independent Study Time 62, Study Time in Lecture 28         Lecturer       Prof. Ginter Rombach         Language       DE         Cycle       WiSe         Content       • skyscrapers: structural elements         • actions on structrues       • bracing systems         • design off 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         • König, G., Liphardt S.: Hochhäuser : Tragwerk und Konstruktiven Ingenieurbau. Springer, Heidelberg 2010         • König, G., Liphardt S.: Hochhäuser : Tragwerk und Konstruktiven Ingenieurbau. Springer, Heidelberg 2010         • König, G., Liphardt S.: Hochhäuser : Tragwerk und Konstruktiven Ingenieurbau. Springer, Heidelberg 2010         • König, G., Liphardt S.: Hochhäuser : Tragwerk und Konstruktiven Ingenieurbau. Springer, Heidelberg 2010         • König, G., Liphardt S.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005         • 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 1, 287-36	Тур	Lecture
Workload in Hours         Independent Study Time 62, Study Time in Lecture 28           Lecturer         Prof. Günter Rombach           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 2003           • Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktiven. Stuttgart, Teubner, 2005           • Deutscher Ausschuss für Stahlbeton: Heft 600: Erfäuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012           • Deutscher Ausschuss für Stahlbeton: Heft 600: Erfäuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012           • Deutscher Ausschuss für Stahlbeton: Heft 600: Erfäuterungen 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	Hrs/wk	2
Lecturer       Prof. Günter Rombach         Language       DE         Cycle       WiSe         Content       • skyscrapers: structural elements         • actions on structrues       • bracing systems         • design off slabs (line and point supported plates and floor slabs)         • membranes and deep beams         • folded plates and shells         • truiss 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 600: Erläuterungen zu DIN EN 1992-1-1. Beuth Verlag, Berlin 2012         • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1. Beuth Verlag, Berlin 2012         • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1. Beuth Verlag, Berlin 2012         • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1. Beuth Verlag, Berlin 2012         • Deutscher Ausschuss für S	CP	3
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 2003           • 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 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, K., Wippel, Hatten. Verlag Ernst & Sohn, Berlin 1992           • Stiglat, K., Wippel, Hatten. Verlag Ernst & Sohn, Berlin 1992           • Stiglat, K., Wippel, Platten. Verlag Ernst & Soh	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           • 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 Konstrukting, 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 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012           • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012           • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012           • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012           • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN En 1992-1-1, Beuth Verlag, Berlin 2012           • Deutscher Aus	Lecturer	Prof. Günter Rombach
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 aus Stahlbeton. Retonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003         • 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, K., 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	Language	DE
<ul> <li>skyscrapers: structural elements</li> <li>actions on structrues</li> <li>bracing systems</li> <li>design orf slabs (line and point supported plates and floor slabs)</li> <li>membranes and deep beams</li> <li>folded plates and shells</li> <li>truss models</li> <li>reinforced and prestressed members</li> </ul> Literature Vorlesungsunterlagen können im STUDiP heruntergeladen werden <ul> <li>Zlich K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010</li> <li>König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst &amp; Sohn, Berlin 2003</li> <li>Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktiven Ingenieurbau. Springer, Heidelberg 2012 <ul> <li>Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012</li> <li>Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012</li> <li>Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken, Verlag Ernst &amp; Sohn, Berlin 1978</li> <li>Stiglat, K., Wippel, H.: Massive Platten - Ausgewählt Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst &amp; Sohn, Berlin 1992</li> <li>Stiglat, K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst &amp; Sohn, Berlin, 1973</li> </ul></li></ul>	Cycle	WiSe
	Content	<ul> <li>skyscrapers: structural elements <ul> <li>actions on structrues</li> <li>bracing systems</li> <li>design orf slabs (line and point supported plates and floor slabs)</li> <li>membranes and deep beams</li> <li>folded plates and shells</li> <li>truss models</li> <li>reinforced and prestressed members</li> </ul> </li> <li>Vorlesungsunterlagen können im STUDiP heruntergeladen werden</li> <li>Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010</li> <li>König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst &amp; Sohn, Berlin 2003</li> <li>Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005</li> <li>Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken, Verlag Ernst &amp; Sohn, Berlin 1978</li> <li>Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst &amp; Sohn, Berlin 1992</li> <li>Stiglat/Wippel: Platten. Verlag Ernst &amp; Sohn, Berlin 1973</li> <li>Schlaich J.; Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst &amp; Sohn, Berlin, 1978</li> </ul>

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	Prof. Günter Rombach
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 (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			
<b>Recommended Previous</b>	Basics of steel construction (i.e. Steel Structures I and II, BUBC)	)		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	After successful completition, students can			
	<ul> <li>describe the phenomenon of local buckling</li> </ul>			
	<ul> <li>explain warping torsion</li> </ul>			
	<ul> <li>illustrate the behaviour of composite structures</li> </ul>			
	<ul> <li>specify the principles in design of composite structures</li> </ul>			
	<ul> <li>sketch the contructions of steel and composite bridges</li> </ul>			
Skills	After successful participation students are able to			
	<ul> <li>check stiffened and unstiffened plated structures</li> </ul>			
	<ul> <li>recognize and verify warping tosion in strucures</li> </ul>			
	design composite structures			
	<ul> <li>design bridges and o perform the detailing</li> </ul>			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Compu	ilsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elec	ctive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective C	Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Cor	mpulsory		
	International Management and Engineering: Specialisation II. C	ivil Engineering: Elective Com	oulsory	

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	<ul> <li>Local-buckling of plated structures</li> <li>Warping torsion</li> <li>Composite-girders, -columns, -slabs, -bridges</li> <li>Principles in composite constructions</li> <li>Bridge-design and -construction</li> </ul>	
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	urse L1205: Steel and Composite Structures	
Тур	Recitation Section (large)	
Hrs/wk	2	
CP	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
	Independent Study Time 32, Study Time in Lecture 28
Lecturer	
Language	
Cycle	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
	<ul> <li>Ahlgrimm, J., Lohrer, I.: Erneuerung der Eisenbahnüberführung in Fulda-Horas über die Fulda, Stahlbau 74 (2005), Heft 2, S.</li> <li>114</li> </ul>

Courses				
Title	<b>,</b>	Тур	Hrs/wk	СР
Sustainability Management (L0007 Hydro Power Use (L0013)	)	Lecture Lecture	2	1
Wind Turbine Plants (L0011)		Lecture	2	3
Wind Energy Use - Focus Offshore	(L0012)	Lecture	1	1
Module Responsible	Dr. Isabel Höfer			
Admission Requirements				
	Module: Technical Thermodynamics I,			
Knowledge				
J.	Module: Technical Thermodynamics II,			
	Module: Fundamentals of Fluid Mechanic	s		
	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				6 1. J. J.
Knowledge		plain in detail knowledge of wind turbines w		
		ment these aspects in consideration of curre		
		ter power to generate electricity. The studen	ts reproduce and explain	i the basic procedi
	in the implementation of renewable ener	gy projects in countries outside Europe.		
	Through active discussions of various t	opics within the seminar of the module, st	udents improve their un	derstanding and
	application of the theoretical background	d and are thus able to transfer what they hav	e learned in practice.	
Skille	Students are able to apply the acquire	d theoretical foundations on exemplant wat	tor or wind nowor system	ms and avaluate
SKIIIS		d theoretical foundations on exemplary wat ships in the context of dimensioning and op		
		for the implementation of renewable energy		
		and can apply this procedure on exemplary th		cside Europe with
Personal Competence				
Social Competence	Students can discuss scientific tasks sul	pjet-specificly and multidisciplinary within a s	eminar	
boeiar competence				
Autonomv	Students can independently exploit sou	rces in the context of the emphasis of the	lecture material to clear	r the contents of
	lecture and to acquire the particular kno			
	·····			
	Independent Study Time 96, Study Time	in Lecture 84		
Credit points				
Course achievement				
	Written exam			
	2.5 hours written exam + written elabor	ation (incl. presentation) in sustainability mai	nagement	
scale				
-	Civil Engineering: Specialisation Structur			
Following Curricula	Civil Engineering: Specialisation Geotech			
	Civil Engineering: Specialisation Coastal	• • • • •	`empulcer/	
		Specialisation Energy Engineering: Elective C ing: Specialisation II. Energy and Environmen		Compulson
	5 5	ing: Specialisation II. Renewable Energy: Elec	5 5	compulsory
		duction: Specialisation II. Renewable Energy. Elect		
		duction: Specialisation Product Development		
		duction: Specialisation Materials: Elective Co		
	Renewable Energies: Core qualification:			
	• ·	hnical Complementary Course: Elective Com	oulsory	
	5 5	cialisation Energy Systems: Elective Compute	5	
		ronmental Process Engineering: Elective Com	•	
	Water and Environmental Engineering: S			
	5 - 5 -			

Course L0007: Sustainability	Management
Тур	Lecture
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Anne Rödl
Language	DE
Cycle	SoSe
Content	The lecture "Sustainability Management" gives an insight into the different aspects and dimensions of sustainability. First, essential terms and definitions, significant developments of the last years, and legal framework conditions are explained. The various aspects of sustainability are then presented and discussed in detail. The lecture mainly focuses on concepts for the implementation of the topic sustainability in companies:
	<ul> <li>What is "sustainability"?</li> <li>Why is this concept an important topic for companies?</li> <li>What opportunities and business risks are addressed or are associated with it?</li> <li>How can the often mentioned three pillars of sustainability - economy, ecology, and social- be meaningfully integrated into corporate management despite their sometimes contradictory tendencies, and how a corresponding compromise can be found?</li> <li>What concepts or frameworks exist for the implementation of sustainability management in companies?</li> <li>Which sustainability labels exist for products or companies? What do they have in common, and where do they differ?</li> <li>Furthermore, the lecture is intended to provide insights into the concrete implementation of sustainability aspects into business practice. External lecturers from companies will be invited to report on how sustainability is integrated into their daily processes.</li> <li>In the course of an independently carried out group work, the students will analyze and discuss the implementation of sustainability aspects based on short case studies. By studying and comparing best practice examples, the students will learn about corporate decisions' effects and implications. It should become clear which risks or opportunities are associated if sustainability aspects are taken into account in management decisions.</li> </ul>
Literature	Die folgenden Bücher bieten einen Überblick: Engelfried, J. (2011) Nachhaltiges Umweltmanagement. München: Oldenbourg Verlag. 2. Auflage Corsten H., Roth S. (Hrsg.) (2011) Nachhaltigkeit - Unternehmerisches Handeln in globaler Verantwortung. Wiesbaden: Gabler Verlag.

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

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	<ul> <li>Historical development</li> <li>Wind: origins, geographic and temporal distribution, locations</li> <li>Power coefficient, rotor thrust</li> <li>Aerodynamics of the rotor</li> <li>Operating performance</li> <li>Power limitation, partial load, pitch and stall control</li> <li>Plant selection, yield prediction, economy</li> <li>Excursion</li> </ul>
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	<ul> <li>Introduction, importance of offshore wind power generation, Specific requirements for offshore engineering</li> <li>Physical fundamentals for utilization of wind energy</li> <li>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</li> <li>Foundation engineering, offshore site investigation, presentation of different concepts of offshore foundation structures, planning and fabrication of foundation structures</li> <li>Electrical infrastructure of an offshore wind farm, Inner Park cabling, offshore substation, grid connection</li> <li>Installation of offshore wind farms, installation techniques and auxiliary devices, construction logistics</li> <li>Development and planning of offshore wind farms</li> <li>Operation and optimization of offshore wind farms</li> <li>Day excursion</li> </ul>
Literature	<ul> <li>Gasch, R.; Twele, J.: Windkraftanlagen - Grundlagen, Entwurf, Planung und Betrieb; Vieweg + Teubner, Stuttgart, 2007, 7. Auflage</li> <li>Molly, J. P.: Windenergie - Theorie, Anwendung, Messung; C. F. Müller, Heidel-berg, 1997, 3. Auflage</li> <li>Hau, E.: Windkraftanlagen; Springer, Berlin, Heidelberg, 2008, 4.Auflage</li> <li>Heier, S.: Windkraftanlagen - Systemauslegung, Integration und Regelung; Vieweg + Teubner, Stuttgart, 2009, 5. Auflage</li> <li>Jarass, L.; Obermair, G.M.; Voigt, W.: Windenergie: Zuverlässige Integration in die Energieversorgung; Springer, Berlin, Heidelberg, 2009, 2. Auflage</li> </ul>

Courses				
Title		Тур	Hrs/wk	СР
Digital Building (L1908)		Lecture	2	2
Lean Construction (L1910)		Lecture	2	2
System Dynamics (L1909)		Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>				
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 96, Study Tim	e in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coasta	I Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geoted	chnical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Structu	ural Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water	and Traffic Floctive Compulsory		

Course L1908: Digital Buildir	ng			
Тур	Lecture			
Hrs/wk	2			
CP	2			
Workload in Hours	lependent Study Time 32, Study Time in Lecture 28			
Lecturer	Dr. Katja Maaser			
Language	DE			
Cycle	SoSe			
Content				
Literature				

Course L1910: Lean Construe	ction			
Тур	Lecture			
Hrs/wk	2			
СР	2			
Workload in Hours	ependent Study Time 32, Study Time in Lecture 28			
Lecturer	Theo Herzog			
Language	DE			
Cycle	SoSe			
Content				
Literature				

Course L1909: System Dynami	urse L1909: System Dynamics			
Тур	Lecture			
Hrs/wk	2			
СР	2			
Workload in Hours	ependent Study Time 32, Study Time in Lecture 28			
Lecturer	Markus Salge			
Language	DE			
Cycle	SoSe			
Content				
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	Prof. Günter Rombach						
Admission Requirements	None						
<b>Recommended Previous</b>	Detailed knowledge on the design of conc	rete structures.					
Knowledge	Modules: Reinforced Concrete Structures I+II, Structural Analysis I+II, Mechanics I+II, Concrete Structures						
Educational Objectives	After taking part successfully, students ha	After taking part successfully, students have reached the following learning results					
Professional Competence							
Knowledge	ge 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.						
Skills	The students are able to design reinforced or prestressed concrete bridges.						
Personal Competence							
•	The students can design in teamwork a re	al concrete bridge.					
	-	-					
Autonomy	The students are able to design a prestressed concrete bridge and discuss the problems and results with other students.						
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70					
Credit points							
Course achievement	None						
Examination	Written exam						
Examination duration and	180 minutes						
scale							
Assignment for the	Civil Engineering: Specialisation Structura	l Engineering: Compulsory					
-	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory						
	Civil Engineering: Specialisation Coastal E	ngineering: Elective Compulsory					
	International Management and Engineerin	g: Specialisation II. Civil Engineering: Elective Com	nulcon				

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

Course L0604: Design of Pre	rse L0604: Design of Prestressed Structures and Concreet Bridges				
Тур	citation Section (large)				
Hrs/wk	2				
CP	2				
Workload in Hours	pendent Study Time 32, Study Time in Lecture 28				
Lecturer	Günter Rombach				
Language	DE				
Cycle	SoSe				
Content	See interlocking course				
Literature	See interlocking course				

Module M0756: Soil N	iechanics and	-Dynamics						
Courses								
Title					Тур	Hrs/wk	СР	
Soil Mechanics - Selected Topics (L	0374)				Lecture	2	2	
Soil Dynamics (L0452)					Lecture	3	2	
Experimental Researches in Geotechnics (L0706)					Practical Course	1	2	
Module Responsible	Prof. Jürgen Grabe							
Admission Requirements	None							
<b>Recommended Previous</b>	modules: Mathemati	cs I-III, Mechanics	I-II, Geote	chnics I				
Knowledge	courses: Soil laborat	ory course, (Applie	d structur	al dynamics)				
Educational Objectives	After taking part suc	cessfully, students	have rea	ched the following	ng learning results			
Professional Competence								
Knowledge	After the successful	completion of the	module th	e students shou	ld be able to:			
	- the standard second			- f				
		to apply the basic			amic excitation and to d	latest the relevant na	rameters	
					ne soil dynamic charact			
		hine foundations t			ne son dynamic charact		ite them,	
		<ul> <li>to measure shocks to perform vibration forecast,</li> <li>to evaluate shocks in term to their effect on people and buildings,</li> </ul>						
		ssibilities of isolat			-			
	<ul> <li>to understand</li> </ul>	mechanisms that	cause ear	thquakes and ev	valuate earthquake in te	erm of their magnitud	le and intensity,	
	<ul> <li>to know meth</li> </ul>	ods to determine a	axial pile c	apacity, integrit	y and the dynamic bedo	ling modulus,		
	<ul> <li>to know the m</li> </ul>	• to know the mechanisms that lead to a deformation accumulation due to cyclic loading and to estimate these deformation						
	mathematical	ly,						
	<ul> <li>to distinguish</li> </ul>	the area of applica	ation of th	e method of elas	stodynamics and plasto	dynamics,		
					number of state variable			
		e visous behaviour	of cohesi	ve soils and to c	consider the effects of c	reep and rate-depend	dent shear strength	
	calculations,							
	<ul> <li>to consider th</li> </ul>	e impact of the pa	rtly satura	ted of a seepag	e and shear strength.			
Skills								
Personal Competence								
Social Competence								
Autonomy								
Workload in Hours	Independent Study T	ime 96, Study Tim	ne in Lectu	re 84				
Credit points	6							
Course achievement	Compulsory Bonus	Form		Description				
	Yes 15 %	Subject theor	retical a	nd				
		practical work						
Examination	Written exam							
Examination duration and	150 min							
scale								
Assignment for the	5 5 1		-	-				
Following Curricula	Civil Engineering: Sp			5 5 1	,			
	Civil Engineering: Sp	ecialisation Coasta	al Enginee	ring: Elective Co	mpulsory			

Course L0374: Soil Mechanic	urse 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:					
	- continuum mechanis					
	- constitutive modelling					
	me and rate dependend material behavior of soils					
	- cyclic loading					
	- undrained conditions					
Literature	Kolymbas D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. Springer Verlag					

Course L0452: Soil Dynamics						
Тур	Lecture					
Hrs/wk	3					
CP	2					
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42					
Lecturer	Alexander Chmelnizkij					
Language	DE					
Cycle	SoSe					
Content	• mass-spring-damper systems,					
	wave propagation in soils,					
	dynamic soil parameters,					
	ermination of dynamic soil parameters,					
	chine foundations,					
	tu measurement of ground motion, ground motion prediction, evaluation of ground motion,					
	und motion shielding,					
	roduction into earthquake engineering,					
	• dynamic pile tests,					
	cyclic accumulation,					
	• plastodynamics					
Literature	<ul> <li>Das B.M.: Fundamentals of Soil Dynamics, Elsevier</li> <li>Empfehlungen des Arbeitskreises Baugrunddynamik. Hrsg. Deutsche Gesellschaft für Geotechnik (DGGT)</li> <li>Haupt W.: Bodendynamik. Vieweg und Teubner</li> <li>Meskouris K. und Hinzen KG.: Bauwerke und Erdbeben. Vieweg Verlag</li> <li>Studer J.A., Koller M.G. und Laue J.: Bodendynamik, Springer Verlag</li> </ul>					

Course L0706: Experimental	Researches in Geotechnics
Тур	Practical Course
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Marius Milatz
Language	DE
Cycle	SoSe
Content	<ul> <li>The students are supposed to:</li> <li>become acquainted with geotechnical model tests, field tests and laboratory tests as well as corresponding measurement</li> </ul>
	<ul> <li>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.</li> <li>gain insight into current soil mechanical research.</li> </ul>
	<ul> <li>plan, coordinate, perform and evaluate soil mechanical tests in a team.</li> <li>discuss, reflect, review and present the obtained results in a group.</li> </ul>
	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.
	<ul> <li>Normen zu geotechnischen Versuchsgeräten und Versuchsverfahren:</li> <li>DIN 18135:2012-04: Baugrund, Untersuchung von Bodenproben -</li> <li>Eindimensionaler Kompressionsversuch, Deutsches Institut für</li> <li>Normung, e. V.</li> </ul>
	- DIN 18137-2:2011-04: Baugrund, Untersuchung von Bodenproben - Bestimmung der Scherfestigkeit - Teil 2: Triaxialversuch, Deutsches Institut für Normung e. V.

C						
Courses						
Title	<b>`</b>			Тур	Hrs/wk	СР
Boundary Element Methods (L0523				Lecture	2	3 3
Boundary Element Methods (L0524		-		Recitation Section (large)	2	3
Module Responsible						
Admission Requirements	None					
	Mechanics I (Statics, Mathematics I, II, III (i			II (Hydrostatics, Kinematics, Dyn	amics)	
Educational Objectives	After taking part succ	cessfully, students	s have reached the foll	lowing learning results		
Professional Competence		-				
Knowledge			owledge regarding the dical basis of the meth	derivation of the boundary eler nod.	ment method an	d are able to give
Skills	The students are capable to handle engineering problems by formulating suitable boundary elements, assembling corresponding system matrices, and solving the resulting system of equations.					
	The students are abl	le to independent	specific problems to ar ly solve challenging c sults are critically scrut	omputational problems and dev	elop own bounda	ary element routing
Workload in Hours	Independent Study Ti	ime 124, Study Ti	ime in Lecture 56			
Credit points	6					
Course achievement	Compulsory Bonus	<b>Form</b> Midterm	Description	1		
Examination						
Examination duration and scale	90 min					
Assignment for the	Civil Engineering: Spe	ecialisation Struct	ural Engineering: Elect	tive Compulsory		
Following Curricula	Civil Engineering: Spe	ecialisation Geote	chnical Engineering: E	lective Compulsory		
	Civil Engineering: Spe	ecialisation Coast	al Engineering: Electiv	e Compulsory		
	Energy Systems: Core	e qualification: El	ective Compulsory			
	Mechanical Engineeri	ing and Managem	ent: Specialisation Pro	duct Development and Production	on: Elective Com	oulsory
	Mechatronics: Specia	lisation System D		lcon		
		insucion system b	esign: Elective Compu	lisory		
	Product Development	-		cation: Elective Compulsory		
	•	t, Materials and P	roduction: Core qualified	cation: Elective Compulsory		
	Technomathematics:	t, Materials and P Specialisation III.	roduction: Core qualifi Engineering Science:	cation: Elective Compulsory		

Course L0523: Boundary Eler	Course L0523: Boundary Element Methods		
Тур	Lecture		
Hrs/wk	2		
СР	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Otto von Estorff		
Language	EN		
Cycle	SoSe		
Content	- Boundary value problems		
	- Integral equations		
	- Fundamental Solutions		
	- Element formulations		
	- Numerical integration		
	- Solving systems of equations (statics, dynamics)		
	- Special BEM formulations		
	- Coupling of FEM and BEM		
	- Hands-on Sessions (programming of BE routines)		
	- Applications		
Literature	Gaul, L.; Fiedler, Ch. (1997): Methode der Randelemente in Statik und Dynamik. Vieweg, Braunschweig, Wiesbaden		
	Bathe, KJ. (2000): Finite-Elemente-Methoden. Springer Verlag, Berlin		
1			

ourse L0524: Boundary Element Methods	
Тур	Recitation Section (large)
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Otto von Estorff
Language	EN
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Courses				
Title		Тур	Hrs/wk	СР
Groundwater Modeling using Modflow (L0543)		Lecture	1	1
Groundwater Modeling using Modfl Modeling of Water Supply and Sew		Recitation Section (small) Project-/problem-based Learning	2 2	2 3
Module Responsible		roject problem bused Learning	2	5
Admission Requirements	None			
Recommended Previous				
Knowledge				
	<ul> <li>groundwater hydraulics and transport of substance</li> </ul>	inces		
	Pipe Systems			
	<ul> <li>Knowledge on urban water infrastructures, in</li> </ul>	narticular drinking water systemsand u	urban drainad	o systems includi
	special structures	i particular armining water systemsand t	indun urunnug	e systems menual
	Hydraulics of drinking water supply systems an	d sewer systems		
	Basic knowledge on water management			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence	5,	5		
Knowledge	The students are able to describe the modelling of groundwater flow and transport as well as urban water infrastructures. They			
	carry out systems analyses and can detect technical and conceptual weak points within the systems in case stud			studies. Besides th
are able to analyse interdependencies of hydraulic and toxic phenomena in soil and water.				
Skills	Skills The students are able to construct and apply scientific groundwater models indipendently. They can work on different and can compare or assess different solutions for existing problems by application of selected software products. The students are different activities (c.e., EDANET, EDA SWAM)			
			cts. The students a	
	able to use different software solutions (e.g. EPANET,			
Personal Competence	Wird pickt vormittelt			
Sucial Competence	Wird nicht vermittelt.			
Autonomy	Wird nicht vermittelt.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Course achievement	None			
Examination	Oral exam			
	20 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineerin	5 1 5		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Civil Engineering: Specialisation Coastal Engineering:	• • •		
	Civil Engineering: Specialisation Coastal Engineering: Civil Engineering: Specialisation Water and Traffic: Ele			
	Water and Environmental Engineering: Specialisation			
	Water and Environmental Engineering: Specialisation			
	Water and Environmental Engineering: Specialisation			

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 and Sewer 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, Weitere Mitarbeiter	
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)		Lecture	2	2
Urban Infrastructures (L0874)		Project-/problem-based Learning	2	4
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
<b>Recommended Previous</b>	Knowledge on Urban planning			
Knowledge	Knowledge on Urban planning			
	<ul> <li>Knowledge on measures for climate protection</li> <li>General knowledge of scientific writing/working</li> </ul>			
	General knowledge of sciencific writing/working			
Educational Objectives	After taking part successfully, students have reached the followin	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 innovation	ns and explain why these contril	bute to the im	provement of urb
	life. They can, for example, derive and discuss measures for effective noise abatement.			
CL 111				
Skills Students are able to develop specific solutions for correcting existing or future environment-related pro				
	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 select technical innovations and integrate them intr			
	context.	Select technical innovations a	nu integrate t	nem into the un
Personal Competence				
	The students can work together in international groups			
Social competence	P The students can work together in international groups.			
Autonomy	Students are able to organize their work flow to prepare themselves for presentations and contributions to the discussions. Th			
	can acquire appropriate knowledge by making enquiries independ	dently.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement	None			
Examination	Written elaboration			
Examination duration and				
scale				
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			
-	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Elective Cor			
	Civil Engineering: Specialisation Water and Traffic: Elective Comp			
	Environmental Engineering: Core qualification: Elective Compulso			
	Joint European Master in Environmental Studies - Cities and Susta		npulsorv	
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure			
			,	
	Water and Environmental Engineering: Specialisation Environmen	it: Elective Compulsorv		

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	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.
F	<ul> <li>Car Free Cities.</li> <li>Multifunctional Places in Cities.</li> <li>The Sustainability of Freight Transport in Cities.</li> </ul>
Literature	Depends on chosen topic.

Courses					
		-	11 - 7 - 1	<u></u>	
<b>Title</b> Coastal- and Flood Protection (L08)	10)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 3	
Coastal- and Flood Protection (L080		Project-/problem-based Learning	1	1	
Maintennance and Defence of Floo	-	Lecture	2	2	
Module Responsible	Prof. Peter Fröhle				
Admission Requirements	None				
<b>Recommended Previous</b>	Coastal Engineering I				
Knowledge					
Educational Objectives	After taking part successfully, students have reached the fol	llowing learning results			
<b>Professional Competence</b>					
Knowledge	The students have the capability to define and explain in c	detail the important aspects of erosi	on protection	and flood protect	
	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 functional and from the constructional point of view.				
<i></i>	L		<i>c</i>		
Skills	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 ta	isks.			
Personal Competence					
Social Competence	The students are able to deploy their gained knowledge in	n applied problems such as the fund	ctional and co	onstructive design	
	coastal and flood protection structures. Additionaly, they wil	Il be able to work in team with engine	eers of other d	lisciplines.	
Autonomy	The students will be able to independently extend their know	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 130 min. The examination includes tasks with respect to the general understanding of		understanding of		
scale	lecture contents and calculations tasks.				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elec	ctive Compulsory			
	Civil Engineering: Specialisation Geotechnical Engineering: E	Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: I	Liective compuisory			

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	DE
Cycle	SoSe
Content	Protection of sandy coasts
	Sediment transport
	Morphology     Tablical solution for the antibaction of and the sector
	<ul> <li>Technical solution for the protection of sandy coasts</li> <li>Construction in direction of the coast</li> </ul>
	<ul> <li>Constructions perpendicular to the coast</li> <li>Other Concepst</li> </ul>
	Calculation approaches and numerical models
	Calculation approaches and numerical models
	Flood Protection
	Classification of constructions / measures
	• Dikes
	• Dunes
	Foreland - constructions
	Flood-Protection Walls
	Drainage of the hinterland
Literature	Vorlesungsumdruck
	Coastal Engineering Manual CEM
L	

Course L1415: Coastal- and	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	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L1411: Maintennance	ourse L1411: Maintennance 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	DE	
Cycle	SoSe	
Content	<ul> <li>Dike protection</li> <li>Maintennance of flood protection measures</li> </ul>	
Literature	Vorlesungsumdruck	

Courses				
Title		Тур	Hrs/wk	СР
Harbour Engineering (L0809)		Lecture	2	2
Harbour Engineering (L1414) Port Planning and Port Constructio	N (1 0 2 7 0)	Project-/problem-based Learning Lecture	1 2	2
Module Responsible		Lecture	Z	Z
Admission Requirements				
Recommended Previous				
Kecommended Previous Knowledge	basics of coastal engineering			
-	After taking part successfully, students have reached the following	na learnina results		
Professional Competence	After taking part successionly, statents have reached the following			
•	The students are able to define in details and to choose design approaches for the functional design of a port and apply the			
Khowledge	design tasks. They can design the fundamental elements of a po	•••	lesign of a po	it and apply then
	design tasks. They can design the fundamental elements of a po			
Skills	The students are able to select and apply appropriate approaches for the functional design of ports.			
Personal Competence				
	The students are able to deploy their gained knowledge in applied problems such as the functional design of ports. Additional			of ports. Additiona
···· // // //	they will be able to work in team with engineers of other disciplin	•	J	
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 examination	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: Electi	ive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Compulsor	у		
	Civil Engineering: Specialisation Water and Traffic: Elective Com	pulsory		
	International Management and Engineering: Specialisation II. Civ	il Engineering: Elective Compuls	ory	
	Theoretical Mechanical Engineering: Technical Complementary C	Course: Elective Compulsory		

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

Course L1414: Harbour Engi	rse 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	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	<ul> <li>Planning and implementation of major projects</li> <li>Market analysis and traffic relations</li> <li>Planning process and plan</li> <li>Port planning in urban neighborhood</li> <li>Development of the logistics center "Port of Hamburg" in the metropolis</li> <li>Quays and waterfront structure</li> <li>Special planning Law Harbor - securing of a flexible use of the port</li> <li>Dimensioning of quays</li> <li>Flood protection structures</li> <li>Port of Hamburg - Infrastructure and development</li> <li>Preparation of areas</li> <li>Scour formation in front of shore structures</li> </ul>
Literature	Vorlesungsumdruck, s. www.tu-harburg.de/gbt

Courses				
Title		Тур	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	aries (L0810)	Lecture	3	4
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
<b>Recommended Previous</b>	Coastal Hydraulic Engineering I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the for	ollowing learning results		
Professional Competence				
Knowledge	e Students are able to define in detail the basic processes that are related to the modelling of flows in hydraulic engined			draulic engineerir
	Besides, they can describe the basic aspects of numerical modelling and actual numerical models for the simulation of flows and			
	waves.			
<i></i>				
Skills	Students are able to apply hydrodynamic-numerical model	s to practical hydraulic engineering ta	SKS.	
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 te			
	with others.			
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 3 hours. The examin	ation includes tasks with respect to	the general u	Inderstanding of t
	lecture contents and calculations tasks.		5	5
	Civil Engineering: Specialisation Structural Engineering: Ele	ective Compulsory		
Assignment for the				
-	Civil Engineering: Specialisation Scretchical Engineering: Ere			

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	<ul> <li>Fundamentals of hydraulic models</li> <li>Model laws</li> <li>Pi theorem of Buckingham</li> <li>Practical examples of hydraulic models</li> </ul> Strobl, Zunic: Wasserbau, Kap. 11 Hydraulische Modelle, Springer
Literature	Selos, zanc. Wasselbau, kap. 11 Hydraulische Modelle, Springer

Course L0812: Modelling of	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	<ul> <li>Waves, interactions with shallow water and constructions</li> <li>Wave theories</li> <li>Sea state and surges</li> <li>Development of waves</li> <li>Wave spectra</li> <li>Modelling of Waves / phase averaged and phase resolved models</li> <li>Application of a phase averaged model for wave prediction (SWAN)</li> <li>Application of phase resolved wave models (Mike)</li> </ul>	
Literature	Vorlesungsumdruck	

	low in Rivers and Estuaries
	Lecture
Hrs/wk	
СР	4
	Independent Study Time 78, Study Time in Lecture 42
	Dr. Edgar Nehlsen, Prof. Peter Fröhle
Language	
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 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), 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 fü 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
Wastewater Systems - Collection, T	reatment and Reuse (L0934)	Lecture	2	2
Wastewater Systems - Collection, T		Recitation Section (large)	) 1	1
Advanced Wastewater Treatment (I	L0357)	Lecture	2	2
Advanced Wastewater Treatment (I	L0358)	Recitation Section (large)	) 1	1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
<b>Recommended Previous</b>	Knowledge of wastewater management and the key processes involved in wastewater treatment.			
Knowledge				
Educational Objectives	After taking part successfully, students have	ve reached the following learning results		
Professional Competence				
Knowledge	Students are able to outline key areas of the	he full range of treatment systems in waste w	vater management, as	s well as their mut
	dependence for sustainable water protection	on. They can describe relevant economic, env	ironmental and social	factors.
<i>CL:</i> !!-	Churchente and able to and design and surply			
SKIIIS		ain the available wastewater treatment proce	esses and the scope of	or their application
	municipal and for some industrial treatmen	it plants.		
Personal Competence				
Social Competence	Social skills are not targeted in this module.			
Autonomy		subject and to organize their work flow inde	pendently. 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 Structural	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnic	cal Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal En	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and	Traffic: Compulsory		
	Bioprocess Engineering: Specialisation A - 0	General Bioprocess Engineering: Elective Com	pulsory	
			ve Compulsory	
	Energy and Environmental Engineering: Sp	ecialisation Environmental Engineering: Electi	ve compaisory	
	Environmental Engineering: Specialisation	Water: Elective Compulsory		
	Environmental Engineering: Specialisation	• •		Compulsory
	Environmental Engineering: Specialisation International Management and Engineering International Management and Engineering	Water: Elective Compulsory g: Specialisation II. Process Engineering and Bi g: Specialisation II. Energy and Environmental	otechnology: Elective Engineering: Elective	
	Environmental Engineering: Specialisation International Management and Engineering International Management and Engineering Process Engineering: Specialisation Environ	Water: Elective Compulsory g: Specialisation II. Process Engineering and Bi g: Specialisation II. Energy and Environmental nmental Process Engineering: Elective Comput	otechnology: Elective Engineering: Elective	
	Environmental Engineering: Specialisation International Management and Engineering International Management and Engineering Process Engineering: Specialisation Enviror Process Engineering: Specialisation Process	Water: Elective Compulsory g: Specialisation II. Process Engineering and Bi g: Specialisation II. Energy and Environmental amental Process Engineering: Elective Compul s Engineering: Elective Compulsory	otechnology: Elective Engineering: Elective	
	Environmental Engineering: Specialisation International Management and Engineering International Management and Engineering Process Engineering: Specialisation Enviror Process Engineering: Specialisation Process Water and Environmental Engineering: Spe	Water: Elective Compulsory g: Specialisation II. Process Engineering and Bi g: Specialisation II. Energy and Environmental amental Process Engineering: Elective Compul s Engineering: Elective Compulsory	otechnology: Elective Engineering: Elective	

Course L0934: Wastewater S	systems - Collection, Treatment and Reuse
Тур	Lecture
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
	<ul> <li>•Understanding the global situation with water and wastewater</li> <li>•Regional planning and decentralised systems</li> <li>•Overview on innovative approaches</li> <li>•In depth knowledge on advanced wastewater treatment options for different situations, for end-of-pipe and reuse</li> <li>•Mathematical Modelling of Nitrogen Removal</li> <li>•Exercises with calculations and design</li> </ul>
Literature	Henze, Mogens: Wastewater Treatment: Biological and Chemical Processes, Springer 2002, 430 pages George Tchobanoglous, Franklin L. Burton, H. David Stensel: Wastewater Engineering: Treatment and Reuse, Metcalf & Eddy McGraw-Hill, 2004 - 1819 pages

Course L0943: Wastewater Systems - Collection, Treatment and Reuse	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Ralf Otterpohl
Language	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	
Cycle	
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 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	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	
<b>Title</b> City Planning (L1066)	TypHrs/wkCPProject-/problem-based Learning46
Module Responsible	Prof. Carsten Gertz
Admission Requirements	None
<b>Recommended Previous</b>	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
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:
	<ul> <li>read and analyze urban development concepts and designs for streetscapes</li> </ul>
	appraise such concepts in the context of competing requirements.
	<ul> <li>design, justify and reflect their own solutions for concrete examples.</li> </ul>
Personal Competence	
Social Competence	Students are able to:
	discuss intermediate results with each other.
	constructively accept feedback on their own work.
	<ul> <li>provide constructive feedback to others.</li> </ul>
Autonomy	Students are able to:
	<ul> <li>independently complete a written report including drawings following a broadly pre-defined process.</li> </ul>
	<ul> <li>assess the consequences of their proposed solutions.</li> </ul>
	<ul> <li>independently acquire knowledge and apply this to new issues or problem areas.</li> </ul>
Werklood in Heure	Independent Study Time 124, Study Time in Lecture 56
Workload in Hours Credit points	
Course achievement	
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 Water: 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:
	<ul> <li>legal framework,</li> <li>instruments and methods of planning,</li> <li>functional requirements,</li> <li>stakeholders and actors</li> <li>basic design requirements</li> <li>different planning levels and</li> <li>historical contexts.</li> </ul> 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 (2009) Stadtplanung: Eine illustrierte Einführung. Primus Verlag. Darmstadt. Frick, Dieter (2008) Theorie des Städtebaus: Zur baulich-räumlichen Organisation von Stadt. 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.

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Courses				
Title	Ту	p	Hrs/wk	СР
Construction Logistics (L1163)		cture	1	2
Construction Logistics (L1164)		citation Section (small)	1	2
Project Development and Managen Project Development and Managen		cture bject-/problem-based Learning	1	1
		Ject-/problem-based Learning	1	1
Module Responsible Admission Requirements	None			
Recommended Previous	none			
Knowledge	none			
	After taking part successfully, students have reached the following le	oproing recults		
	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	d project development and m	anagement	
	<ul> <li>name advantages and disadvantages of internal or external content</li> </ul>	onstruction logistics		
	<ul> <li>explain characteristics of products, demand and production or</li> </ul>	of construction objects and the	eir consequer	nces for construction
	specific supply chains			
	<ul> <li>differentiate constructions logistics from other logistics system</li> </ul>	ns		
Skills	Students can			
	<ul> <li>carry out project life cycle assessments</li> </ul>			
	apply methods and instruments of construction logistics			
	apply methods and instruments of project development and m	nanagement		
	apply methods and instruments of conflict management			
	<ul> <li>design supply and waste removal concepts for a construction</li> </ul>	project		
Personal Competence				
Social Competence	Students can			
	hold presentations in and for groups			
	<ul> <li>apply methods of conflict solving skills in group work and case</li> </ul>	e studies		
Autonomy	Students can			
	<ul> <li>salve problems by balistic, systemic and flow oriented thinking</li> </ul>	a.		
	<ul> <li>solve problems by holistic, systemic and flow oriented thinking</li> <li>improve their creativity, negotiation skills, conflict and crise</li> </ul>		methods of	moderation in ca
	studies	es solution skins by applying	methous of	
	stuties			
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 Corr	npulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective C	Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Compu	ulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Compulse	ory		
	International Management and Engineering: Specialisation II. Civil En	ngineering: Elective Compulso	ory	
	International Management and Engineering: Specialisation II. Logistic	cs: Elective Compulsory		
	Logistics, Infrastructure and Mobility: Specialisation Production and L	Logistics: Elective Compulsory	/	
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure an	nd 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: <ul> <li>competetive factor logistics</li> <li>the concept of systems, planning and coordination of logistics</li> <li>material, equipment and reverse logistics</li> <li>IT in construction logistics</li> <li>elements of the planning model of construction logistics and their connections</li> <li>flow oriented logistics systems for construction projects</li> <li>logistics concepts for ready to use construction projects (especially procurement and waste removel logistics)</li> <li>best practice examples (construction logistics Potsdamer Platz, recent case study of the region)</li> </ul> <li>Contents of the lecture are deepened in special exercises.</li>
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)

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	
	<ul> <li>Advantages and disadvantages of different ways of project handling</li> </ul>	
	<ul> <li>organization, information, coordination and documentation</li> </ul>	
	cost and fincance management in projects	
	<ul> <li>time- and capacity management in projects</li> </ul>	
	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	Irse 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. Uwe Starossek			
Admission Requirements	None			
<b>Recommended Previous</b>	Knowledge of linear structural analysis of	of statically determinate and indeterminate struct	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				
Knowledge	After successful completion of this modu	ule, the student can explain the basic aspects of d	lynamic effects o	on structures and t
	respective methods.			
Skills	After successful completion of this module, the students will be able to predict the response of material and structures dynamics loading using the appropriate computational approaches and methods.			
Personal Competence Social Competence	Students can			
,				
	<ul> <li>participate in subject-specific and i</li> </ul>			
	<ul> <li>defend their own work results in from</li> </ul>			
	<ul> <li>promote the scientific development</li> </ul>	-		
	<ul> <li>Furthermore, they can give and account</li> </ul>	cept professional constructive criticism		
Autonomy	Students are able to gain knowledge of th	he subject area from given and other sources and a	pply it to new pr	oblems. Furthermo
		ocess for problems in the area of Structural Analysis		
Workload in Hours	Independent Study Time 96, Study Time i	in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	150 min			
scale				
	Civil Engineering: Specialisation Structura	al Engineering: Compulsory		
Following Curricula				
Following Curricula	Civil Engineering: Specialisation Geotechr			
	Civil Engineering: Specialisation Coastal E			
	Civil Engineering: Specialisation Water an International Management and Engineerir			

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. Uwe Starossek
Language	DE
Cycle	SoSe
Content	<ul> <li>Single-degree-of-freedom systems: undamped and damped vibration, free vibration, forced vibrations due to harmonic, periodical or arbitrary loading, natural frequency, damping</li> <li>vibration isolation</li> <li>solution in the frequency-domain (Fourier transformation), solution in the time-domain</li> <li>multi-degree-of-freedom systems: continuous or discrete systems, modelling with finite elements, generalisation</li> <li>modal analysis</li> <li>power iteration according to v.Mises</li> <li>earthquake loading: seismological basics, response spectrum method</li> <li>wind-induced vibrations: engineering meteorology, aerodynamic, classification of excitation mechanisms</li> </ul>
Literature	Clough, R.W., Penzien, J.: Dynamics of Structures. 2. Aufl., McGraw-Hill, New York, 1993.

Course 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. Uwe Starossek
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Тур	Lecture
Hrs/wk	
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Jürgen Priebe
Language	DE
Cycle	SoSe
Content	<ul> <li>basics of fatigue stress and fatigue resistance and determination of fatigue strength,</li> </ul>
	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,
	<ul> <li>set up of determination of fatigue strength in different examples,</li> </ul>
	<ul> <li>basics of construction and design regarding the problem of material fatigue,</li> </ul>
	<ul> <li>basics of linear elastic fracture mechanics under static and dynamic load,</li> </ul>
	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 1996
	Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993
	<ul> <li>DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsreg</li> <li>Bemessungsregeln f         ür den Hochbau; 1993</li> </ul>
	• 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 200

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		
Steel Construction Project (L1206)		Project Seminar	4	6		
Module Responsible	Prof. Marcus Rutner					
Admission Requirements	None					
<b>Recommended Previous</b>	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 wh	nole 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 participants 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 have the ability to work for a broad agreement with respect to intergroup dependencies.					
	They can distribute and process tasks independently.					
Autonomy	Students can handle their part of the project	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 Geotechnica	l Engineering: Elective Compulsory				
Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory					
	Civil Engineering: Specialisation Structural En	aineering: Compulsory				

Course L1206: Steel Constru	ction 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	Hydraulic Engineering (L1146)	Lecture	2	2	
Module Responsible	Prof. Jürgen Grabe				
Admission Requirements	None				
<b>Recommended Previous</b>	complete modules: Geotechnics I-III, Mathema	tics I-III			
Knowledge					
	courses: Soil laboratory course				
Educational Objectives	After taking part successfully, students have r	eached the following learning results			
Professional Competence					
Knowledge					
Skills					
Personal Competence					
Social Competence					
Autonomy					
Workload in Hours	Independent Study Time 110, Study Time in L	ecture 70			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	90 min				
scale					
Assignment for the	Civil Engineering: Specialisation Geotechnical	Engineering: Compulsory			
Following Curricula	Civil Engineering: Specialisation Structural Eng	ineering: Elective Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Compulsory				
	Theoretical Mechanical Engineering: Specialisa	ation Maritime Technology: Elective Compulsory	1		
	Theoretical Mechanical Engineering: Technical	Complementary Course: Elective Compulsory			
	Water and Environmental Engineering: Specia				
	Water and Environmental Engineering: Specia				
	Water and Environmental Engineering: Specia	isation Water: 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	<ul> <li>Geotechnical investigation an description of the seabed</li> <li>Foundations of Offshore-Constructions</li> <li>cCliff erosion</li> <li>Sea dikes</li> <li>Port structures</li> <li>Flood protection structures</li> </ul>
Literature	<ul> <li>EAK (2002): Empfehlungen für Küstenschutzbauwerke</li> <li>EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke</li> <li>Poulos H.G. (1988): Marine Geotechnics. Unwin Hyman, London</li> <li>Wagner P. (1990): Meerestechnik: Eine Einführung für Bauingenieure. Ernst &amp; Sohn, Berlin</li> </ul>

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	res 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 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 (L025	(4)	Lecture		1	1
Module Responsible	Prof. Frank Schmidt-Döhl					
Admission Requirements	None					
<b>Recommended Previous</b>	Basic knowledge about building materials, building physics and building chemistry, for example by the modules Principles o					
Knowledge	Building Materials and Building	Physics and Buildin	ng Materials and Buildir	g Chemistry.		
Educational Objectives	After taking part successfully, st	udents have reac	hed the following learni	ng results		
<b>Professional Competence</b>						
Knowledge	The students are able to describ	e the components	s of mineral building ma	terials and their functio	n in detail an	d to use them for t
	manufacture of special mineral	building materials	. They are able to show	the characteristics of m	ineral buildin	g materials. They
	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.					
o						
Skills	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 repart					
	and strengthening measures.					
Deveenal Competence						
Personal Competence	The students are able to develo	n in small group t	he mixture of a special	martar Thou procent th	oir roculto to	the lasturer and t
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.					
	building material on the basis of	this reedback.				
<b>A</b> (1) (1)	<b>-</b>			Internet for a feature t		
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, S	tudy Time in Lectu	ire 70			
Credit points	6					
Course achievement	Compulsory Bonus Form		Description			
	Yes 20 % Subject	theoretical an	ıd			
	practical	work				
Examination	Written exam					
Examination duration and	120 min					
scale						
Assignment for the	Civil Engineering: Specialisation	Geotechnical Eng	ineering: Compulsory			
Following Curricula	Civil Engineering: Specialisation	Coastal Engineeri	ing: Elective Compulsor	y		
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory					
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory					

Course L0255: Repair of Stru	ictures
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	ourse 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			
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	ourse 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					
		Tour	Line (colo		
<b>Title</b> Smart Monitoring (L2762)		<b>Typ</b> Integrated Lecture	Hrs/wk	<b>CP</b> 2	
Smart Monitoring (L2763)		Recitation Section (small)	2	4	
Module Responsible	Prof. Kay Smarsly				
Admission Requirements	None				
	Basic knowledge or interest in object-oriented modeling, programming, and sensor technologies are helpful. Interest in model				
Knowledge	research and teaching areas, such as Internet of Things skills of scientific working, are required. Basic knowledge	, Industry 4.0 and cyber-physical sy	stems, as well a		
Educational Objectives	After taking part successfully, students have reached the	following learning results			
Professional Competence					
	The students will become familiar with the principles a decentralized smart systems to be applied for contin environment. In addition, the students will learn to desig analysis techniques, modern software design concepts, a also part of this module. In small groups, the studer "intelligent" sensors to be implemented by the studer techniques. The smart monitoring systems will be mound on scaled lab structures for validation purposes. The out module will "automatically" participate with their smart written papers and oral examinations form the final grade	uous (remote) monitoring of syste n and to implement intelligent sense nd embedded computing methodolo ats will design smart monitoring s nts. Specific focus will be put on ted on real-world (built or natural) sy come of every group will be docum to monitoring system in the annual	ms in the built or systems using gies. Besides lect ystems that inte the application ystems, such as ented in a paper "Smart Monitorir	and in the natu state-of-the-art da tures, project work egrate a number of machine learn bridges or slopes, r. All students of t ng" competition.	
Skills					
Personal Competence					
Social Competence					
Autonomy					
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Course achievement	None				
Examination	Written elaboration				
Examination duration and	10 pages of work with 15-minute oral presentation				
scale					
-	Civil Engineering: Specialisation Water and Traffic: Electiv				
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering				
	Civil Engineering: Specialisation Coastal Engineering: Elec				
	Civil Engineering: Specialisation Structural Engineering: E	, ,			
	Civil Engineering: Specialisation Coastal Engineering: Elec				
	Civil Engineering: Specialisation Geotechnical Engineering				
	Civil Engineering: Specialisation Structural Engineering: E				
	Civil Engineering: Specialisation Water and Traffic: Electiv				
	Environmental Engineering: Specialisation Waste and Ene				
	Environmental Engineering: Specialisation Biotechnology:				
	Environmental Engineering: Specialisation Water: Elective				
	Environmental Engineering: Specialisation Waste and Eng				
	Environmental Engineering: Specialisation Biotechnology: Elective Compulsory				
	Environmental Engineering: Specialisation Water: Elective				
	Water and Environmental Engineering: Specialisation Citie				
	Water and Environmental Engineering: Specialisation Citie				
	Water and Environmental Engineering: Specialisation Env				
	Water and Environmental Engineering: Specialisation Env Water and Environmental Engineering: Specialisation Wat				

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	WiSe/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	

Course 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	WiSe/SoSe
Content	The contents of the exercises are based on the lecture contents. In addition to the exercises, project work will be conducted, 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.
Literature	

Courses				
Courses				
Title	(1,022C)	Тур	Hrs/wk	СР
Water Protection and Wastewater I Water Protection and Wastewater I	5	Lecture Project Seminar	3	3 3
Module Responsible			-	_
Admission Requirements				
Recommended Previous				
Knowledge	<ul> <li>Basic knowledge in water managem</li> </ul>	ent;		
	Good knowledge in urban drainage;			
	Good knowledge of wastewater trea			
	<ul> <li>Good knowledge of pollutants (e.g. 0</li> </ul>	COD, BOD, TS, N, P) and their properties;		
Educational Objectives	After taking part successfully, students have	ve reached the following learning results		
Professional Competence				
Knowledge	The students can describe the basic princip	oles of the regulatory framework related to the	ne international and Eu	ropean water sect
	They can explain limnological processes,	substance cycles and water morphology in	n detail. They are able	e to assess comp
	problems related to water protection, suc	h as ecosystem service and wastewater tre	atment with a special	focus on innovat
	solutions, remediation measures as well as	conceptual approaches.		
Skills	Students can accurately assess current pro	oblems and situations in a country-specific o	or local context. They c	an suggest concre
	actions to contribute to the planning of	tomorrow's urban water cycle. Furthermore	, they can suggest ap	opropriate technic
	administrative and legislative solutions to s	solve these problems.		
Personal Competence				
	The students can work together in international groups.			
Social competence	The students can work together in internat			
Autonomy	•	low to prepare presentations and discussion	s. They can acquire ap	propriate knowled
	by making enquiries independently.			
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points				
Course achievement				
Examination	Presentation			
Examination duration and	Term paper plus presentation			
scale				
Accient for the	Civil Engineering: Englishing Structural	Engineering, Elective Compulsory		
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Civil Engineering: Specialisation Geotechni	5 5 1 ,		
r onowing curricula	Civil Engineering: Specialisation Geotechnic Civil Engineering: Specialisation Coastal En	• • • • •		
	Civil Engineering: Specialisation Water and	5 5 1 5		
	Environmental Engineering: Specialisation			
		g: Specialisation II. Civil Engineering: Elective	Compulsory	
		udies - Cities and Sustainability: Specialisation		oulsory
	Water and Environmental Engineering: Spe			-
	Water and Environmental Engineering: Spe	ecialisation Water: Elective Compulsory		
	Water and Environmental Engineering: Spe			

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
	<ul> <li>The lecture focusses on:</li> <li>Regulatory Framework (e.g. WFD)</li> <li>Main instruments for the water management and protection</li> <li>In depth knowledge of relevant measures of water pollution control</li> <li>Urban drainage, treatment options in different regions on the world</li> <li>Rainwater management, improved management of heavy rainfalls, downpours, rainwater harvesting, rainwater infiltration</li> <li>Case Studies and Field Trips</li> </ul>
Literature	<ul> <li>The literature listed below is available in the library of the TUHH.</li> <li>Water and wastewater technology Hammer, M. J. 1., &amp; . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International.</li> <li>Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011) New York, NY: McGraw-Hill.</li> <li>Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ.</li> </ul>

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	5	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			
<b>Recommended Previous</b>	Basic knowledge about building materials or m	naterial science, for example by the mo	odule Building Ma	terials and Buildi
Knowledge	Chemistry.			
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
<b>Professional Competence</b>				
Knowledge	The students are able to describe the rules for tr	ading, use and marking of construction p	roducts in Germar	ny. They know whi
	methods for the testing of building material prope	rties are usable and know the limitations a	and characterics o	f the most importa
	testing methods.			
Chille	s The students are able to responsibly discover the rules for trading and using of building products in Germany.			
SKIIIS			-	tion of domogos o
	They are able to chose suitable methods for the t the examination of the structural conditions of bu			
	are able to describe an examination in form of a t	• • •	inplons to the cau	se of damages. If
Personal Competence Social Competence	The students can describe the different roles of r framework of material testing. They can describe			on bodies within 1
	The students are able to make the timing and the operation steps to learn the specialist knowledge of a very extensive field.			
	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	120 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	ng: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic	Elective Compulsory		
	International Management and Engineering: Speci	alisation II. Civil Engineering: Elective Com	pulsory	
	Materials Science: Specialisation Engineering Mate	erials: Elective Compulsory		

## Course L0260: Examination of Materials, Structural Condition and Damages Typ Lecture Lecture 3 OCP 4 Workload in Hours Independent Study Time 78, Study Time in Lecture 42 Lecturer Prof. Frank Schmidt-Döhl Language DE 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	

_				
Courses				
Title		Тур	Hrs/wk	СР
Nonlinear Structural Analysis (L027		Lecture	3	4
Nonlinear Structural Analysis (L027		Recitation Section (small)	1	2
Module Responsible				
	None			
	Knowledge of partial differential equation	ns is recommended.		
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	Students are able to			
		inear phenomena in structural mechanics.		
		f nonlinear phenomena in structural mechanics.		
		ctural analysis, to identify them in a given situatio	n and to explain th	eir mathematical a
	mechanical background.			
Skills	Students are able to			
	+ model nonlinear structural problems.			
	+ select for a given nonlinear structural	problem a suitable computational procedure.		
	+ apply finite element procedures for no			
	+ critically verify and judge results of no			
		ar solution procedures to new problems.		
Personal Competence				
Social Competence	Students are able to			
		ups and to document the corresponding results.		
	+ share new knowledge with group mer	nbers.		
Autonomy	Students are able to			
	+ acquire independently knowledge to s	olve complex problems.		
Workload in Hours	Independent Study Time 124, Study Tim	e in Lecture 56		
Credit points				
	None			
	Written exam			
Examination duration and scale	120 min			
	Civil Engineering, Coordination Classic	ral Engineering, Elective Commutant		
-	Civil Engineering: Specialisation Structu		mpulcon	
Following Curricula		ing: Specialisation II. Civil Engineering: Elective Co	mpulsory	
	Materials Science: Specialisation Modeli Mechatronics: Specialisation System De	5 1 5		
	Mechatronics: Specialisation System De			
		duction: Core qualification: Elective Compulsory		
	-	ng: Core qualification: Elective Compulsory		
	Ship and Offshore Technology: Core qua	infication: Elective Compulsory :hnical Complementary Course: Elective Compulso	D(	
	Theoretical Mechanical Engineering: Teo	, , , , , , , , , , , , , , , , , , , ,	5	

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	DE/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	ourse 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	DE/EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title		Тур	Hrs/wk	СР
Subsoil and Underground Engineer	-	Lecture	2	2
Service Contract and Procurement		Lecture	2	2
Project Geotechnics (L0708)		Project-/problem-based Learning	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	g learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	30 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Elective Cor	npulsory		
-	Civil Engineering: Specialisation Geotechnical Engineering: Electiv			
<b>2</b>	Civil Engineering: Specialisation Structural Engineering: Elective C	, ,		
	Civil Engineering: Specialisation Water and Traffic: Elective Comp			

Course L0395: Subsoil and U	nderground Engineering Law
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Günther Schalk
Language	DE
Cycle	WiSe
Content	History of Civil Engineering Law (from 1700 BC to 2000 AD)
	• Basics of foundation and excarvation law / engineering law (the participants in the case law of geotechnical law case studies)
	Legal aspects of technical regulations in civil engineering (with case studies)
	• The civil engineering contract (including checklists for the special civil engineering contract design and execution)
	• The liability of the planner and entrepreneur in civil engineering (practical examples, jurisprudence and law, inter alia, to the
	Ordinance on Combatants, liability for defects and traffic safety obligations, construction law and insurance questions)
	• The ground / foundation risk and the systemic risk (also in the European context)
	The total debt in (low) building law (based on practice-oriented case constellations)
	• The (construction) conflict, the dispute avoidance models and the construction process (practice-oriented presentation)
Literature	Folienskript (in der Vorlesung erhältlich)
	weitere Literatur:
	Englert, Grauvogel und Maurer: Handbuch des Baugrund- und Tiefbaurechts. Werner-Verlag

ourse L1906: Service Contract and Procurement Law	
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Günther Schalk, Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	
Literature	

## Module Manual M.Sc. "Civil Engineering"

Course L0708: Project Geote	ourse L0708: Project Geotechnics		
Тур	Project-/problem-based Learning		
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	The students solve independently a project-based geotechnical problem in groups. Additional lectures concerning the problem will		
	be held and material will be distributed as study basis. Every two weeks the groups present their current project status. The final		
	work will be presentated in a final presentation.		
Literature	abhängig von der Fragestellung		

Module M1345: Metal	lic and Hybrid Light-weight Ma	aterials		
Courses				
Title		Тур	Hrs/wk	СР
Joining of Polymer-Metal Lightweigh	nt Structures (L0500)	Lecture	2	2
oining of Polymer-Metal Lightweigh	nt Structures (L0501)	Practical Course	1	1
Metallic Light-weight Materials (L16	560)	Lecture	2	3
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge				
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
,	Independent Study Time 110, Study Time in	Lecture 70		
Credit points				
Course achievement				
Examination				
Examination duration and	45 min			
scale				
-	Civil Engineering: Specialisation Structural E			
Following Curricula	Materials Science: Specialisation Engineering	g Materials: Elective Compulsory		

Тур	Lecture
Hrs/wk	2
CP	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-met
	lightweight structures used in engineering applications. A general understanding of the principles of the consolidated and ne 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
	<ul> <li>Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics</li> </ul>
	Mechanical Fastening of Polymer-Metal Hybrid Structures
	Adhesive Bonding of Polymer-Metal Hybrid Structures
	<ul> <li>Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures</li> </ul>
	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 polymore
	metal lightweight structures as well as their application fields.
Literature	C. T. Amancia Filha, L. A. Plaga, Jaining of Polymor Matal Hybrid Structures, Wilay, 2019
	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
	<ul> <li>J. Friedrich, Metal-Polymer Systems: Interface Design and Chemical Bonding, Wiley, 2017</li> </ul>

Course L0501: Joining of Poly	ourse 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	

Course L1660: Metallic Light	-weight Materials
	Lecture
Hrs/wk	
CP Workload in Hours	
	Independent Study Time 62, Study Time in Lecture 28 Dr. Domonkos Tolnai
Language	
Cycle	
Content	Lightweight construction
	- 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 and applications
	Age-hardenable Al 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
	Examples of applications

	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

Module M1716: Subsi	Irface Processes			
Courses				
Title		Тур	Hrs/wk	СР
Modeling of Subsurface Processes (L2730)		Lecture	2	2
Modeling of Subsurface Processes (L2731)		Recitation Section (small)	1	1
Modern Techniques for Subsurface		Lecture	2	2
Modern Techniques for Subsurface	Solute Transport (L2729)	Recitation Section (large)	1	1
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
<b>Recommended Previous</b>				
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 96, Study Time in L	ecture 84		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Er	ngineering: Elective Compulsory		
-	Civil Engineering: Specialisation Geotechnica			
-	Civil Engineering: Specialisation Coastal Engi	neering: Elective Compulsory		
	Civil Engineering: Specialisation Water and T	raffic: Elective Compulsory		
	Process Engineering: Specialisation Environm	ental Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process E	Engineering: Elective Compulsory		
	Water and Environmental Engineering: Speci	alisation Water: Compulsory		
	Water and Environmental Engineering: Speci	alisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Speci	alisation Cities: Elective Compulsory		

Course L2730: Modeling of Subsurface Processes		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Alexandru Tatomir	
Language	EN	
Cycle	WiSe	
Content		
Literature		

Course L2731: Modeling of S	urse L2731: Modeling of Subsurface Processes	
Тур	Recitation Section (small)	
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	

Course L2728: Modern Techr	ourse L2728: Modern Techniques for 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		
Literature		

Course L2729: Modern Techr	ourse L2729: Modern Techniques for 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	

Courses						
Title				Тур	Hrs/wk	СР
Waste and Environmental Chemist Biological Waste Treatment (L0318				Practical Course	2 nina 3	2 4
-				Project-/problem-based Learn	ling 5	4
Module Responsible						
Admission Requirements						
	chemical and biological basic	CS				
Knowledge						
Educational Objectives	After taking part successfully	r, students have i	reached the followir	ig learning results		
Professional Competence						
Knowledge	The module aims possess kn	owledge concern	ing the planning of	biological waste treatment	plants. Students	are able to explain
	design and layout of anaerol	pic and aerobic w	aste treatment plar	ts in detail, describe differe	ent techniques for	r waste gas treatm
	plants for biological waste tr	eatment plants a	nd explain different	methods for waste analytic	S.	
Skills	The students are able to disc	cuss the compilat	ion of design and la	yout of plants. They can cr	itically evaluate t	echniques and qua
	control measurements. The	students can rec	herché and evaluat	e literature and date conne	ected to the tasks	s given in der mod
	and plan additional tests. Th	ey are capable of	f reflecting and eval	uating findings in the group	).	
Personal Competence						
	Students can participate in	subject-specific a	nd interdisciplinary	discussions develop coop	erated solutions	and defend their o
Social competence	Students can participate in subject-specific and interdisciplinary discussions, develop cooperated solutions and defend their of work results in front of others and promote the scientific development in front of colleagues. Furthermore, they can give a					
	accept professional construct	•	the scientific deve	iophiene in none of coned	gues. Furthermor	c, they can give t
	accept professional construct	cive endelsin.				
Autonomu	Studente con independently	tan knowledge f	rom litoratura, buci	need or test reports and tr	anoform it to the	course projects T
Autonomy	Students can independently					
	are capable, in consultation				-	
	steps on this basis. Furthermore, they can define targets for new application-or research-oriented duties in accordance with			accordance with		
	potential social, economic ar	iu cultural impaci	ι.			
Workload in Hours Credit points	Independent Study Time 110	), Study Time in L	Lecture 70			
Course achievement	Compulsory Bonus Form		Description			
course achievement		ct theoretical	and			
	-	ical work				
Examination	Presentation					
Examination duration and	Elaboration and Presentation	(15-25 minutes	in groups)			
scale		15 25 minutes	y. oup <i>s)</i>			
Assignment for the	Civil Engineering: Specialisat	ion Structural En	aineering: Elective	Compulsory		
Following Curricula						
i onowing curricula	Civil Engineering: Specialisat					
	Civil Engineering: Specialisat	•	•			
	5 5 1			2	Compulsory	
	Energy and Environmental E	• • •		antai Engineering: Elective (	compulsory	
	Environmental Engineering:			ray and Environmental Fra-	incoring, Elective	Compulsory
	International Management a	5 5	•	5,	5	1 5
	nome European Master in Env	nonmental Studi	es - ciues and Susta	ainability: Specialisation Energy	ergy: Elective COP	npulsory
	Water and Environmental En Water and Environmental En	gineering: Specia	alisation Cities: Elect	tive 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	DE/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	<ol> <li>Introduction</li> <li>biological basics</li> <li>determination process specific material characterization</li> <li>aerobic degradation ( Composting, stabilization)</li> <li>anaerobic degradation (Biogas production, fermentation)</li> <li>Technical layout and process design</li> <li>Flue gas treatment</li> <li>Plant design practical phase</li> </ol>
Literature	

Courses							
				<b>T</b>		Live (vile	<b>CD</b>
Title Computational Analysis of Concrete Structures (L0598)			<b>Typ</b> Lecture		Hrs/wk 2	<b>СР</b> 3	
Computational Analysis of Concrete					ection (large)	1	1
E-Modeling of Concrete Structures		(20333)			blem-based Learning	2	2
Module Responsible	Prof. Günte	er Romba	ch				
Admission Requirements	None						
<b>Recommended Previous</b>	Basic knov	vledge in	structural analysis and	design of reinforced concrete stru	ctures (beams, slab	s, shear walls)	
Knowledge	Lectures '	Concrete	Structures I und II'				
	Lectures '	Structura	Analysis I and II'				
	Lecture 'Co	oncrete Si	tructures'				
Educational Objectives	After takin	g part su	ccessfully, students hav	re reached the following learning r	esults		
Professional Competence			-				
Knowledge	The students know the problems of numerical modeling and design of an arbitrary concrete structure.						
Skills	The students can model and design an arbitrary concrete structure by means of a finite element software package.						
Personal Competence							
Social Competence	The studer	nts can m	odel and design in tean	nwork a real concrete structure by	means of a finite e	lement softwa	re package.
Autonomy	The students can model and design a real concrete structure based on a finite element software package and discuss the problem						
	and results with other students.						
Workload in Hours	Independe	nt Study '	Time 110, Study Time i	n Lecture 70			
Credit points	6						
Course achievement	Compulsory	Bonus	Form	Description			
	Yes	None	Excercises	Es ist ein Tragsystem mit	TEDDY zu modellier	ren	
	Yes	None	Attestation	Am Ende des Semster	ist ein Tragsystem	n mit dem R	echenprogramm z
				modellieren			
Examination	Oral exam						
Examination duration and	45 min						
scale							
Assignment for the	Civil Engin	eering: Sp	pecialisation Structural	Engineering: Elective Compulsory			
Following Curricula	Civil Engin	eering: Sp	pecialisation Geotechni	cal Engineering: Elective Compuls	ory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory						

Course L0598: Computationa	al Analysis of Concrete Structures
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Content	<ul> <li>Modeling of beam and truss structures <ul> <li>Discontinuity regions, like frame corners, openings, shear walls with large openings</li> <li>Bracing of high-rise buildings</li> <li>Modeling of bridges</li> <li>Nonlinear analysis</li> </ul> </li> <li>Finite-Elemente-analysis of slabs: support conditions, singularity regions</li> <li>Finite-Elemente-Berechnungen of shear walls and deep beams: support condition, design</li> <li>Coupled systems</li> <li>Modeling of slab supported on beams</li> <li>Shell structures</li> <li>3D building models</li> <li>Nonlinear analysis of slabs and shells</li> <li>Documentation</li> </ul>
Literature	<ul> <li>Vorlesungsumdruck</li> <li>Rombach, G.A. (2007): Anwendung der Finite-Elemente-Methode im Betonbau. 2. Auflage, Verlag Ernst &amp; Sohn, Berlin</li> <li>Rombach G.A. (2011): Finite-Element Design of Concrete Structures, 2nd edition, ICE publishing</li> <li>Hartmann, F., Katz, C. (2002): Statik mit finiten Elementen. Springer, Berlin</li> </ul>

Course L0599: Computationa	urse L0599: Computational Analysis of Concrete Structures		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Günter Rombach		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L0600: FE-Modeling o	of Concrete Structures
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Lukas Henze
Language	DE
Cycle	WiSe
Content	Finite Element Modeling and computational design of concrete structures by 'SOFiSTiK'
Literature	<ul> <li>Rombach G.: Anwendung der Finite - Elemente - Methode im Betonbau. 2. Auflage. Verlag Ernst &amp;.Sohn, Berlin, 2007</li> <li>Rombach G.: Finite-Element Design of Concrete Structures. 2nd edition, ICE Publishing, London, 2011, ISBN 0 7277 32749</li> <li>Rombach G.: EDV-unterstützte Berechnungen im Stahlbetonbau. in: "Stahlbetonbau aktuell 2014" (ed. Gorris A., Hegger J., Mark P.), Berlin 2014 (S. C1C.36)</li> </ul>

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		Lecture	2	2
Water Resource Management (L04		Recitation Section (small)	1	1
Module Responsible				
Admission Requirements	None			
Recommended Previous	Knowledge of water management and the	e key processes involved in water treatment.		
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Skills	outline the organisational structures of water companies. They will be able to explain the available water treatment processes and the scope of their application. Students will be able to assess complex problems in drinking water production and establish solutions involving wate management and technical measures. They will be able to assess the evaluation methods that can be used for this. Students we be able to carry out chemical calculations for selected treatment processes and apply generally accepted technical rules and 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 managemer and treatment of drinking water. They will be able to take an appropriate professional position, for example representing use interests. They will be able to develop joint solutions in teams of diverse experts and present these solutions to others. 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	None			
Examination	Written exam			
Examination duration and	60 min (chemistry) + presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structura	al Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotech	nical Engineering: Elective Compulsory		
-	Civil Engineering: Specialisation Water ar	nd Traffic: Compulsory		
	Civil Engineering: Specialisation Coastal I	Engineering: Elective Compulsory		
	Energy and Environmental Engineering: 5	Specialisation Energy and Environmental Engineer	ing: Elective Comp	ulsory
	International Management and Engineeri	ng: Specialisation II. Energy and Environmental En	gineering: Elective	Compulsory
	Water and Environmental Engineering: Sp	pecialisation Water: Compulsory		
	Water and Environmental Engineering: Sp	pecialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: S			

Course L0311: Chemistry of	Drinking Water Treatment
	Lecture
Hrs/wk	2
СР	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	<ul> <li>MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John Wiley &amp; Sons, Hoboken, 2005.</li> <li>Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley &amp; Sons, New York, 1996.</li> <li>DVGW (Hrsg.): Wasseraufbereitung - Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004.</li> <li>Jensen, J. N.: A Problem Solving Approach to Aquatic Chemistry. John Wiley &amp; Sons, Inc., New York, 2003.</li> </ul>

Course L0312: Chemistry of	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	<ul> <li>The lecture provides comprehensive knowledge on interaction of water ressource management and drinking water supply. Content overview: <ul> <li>Current situation of global water resources</li> <li>User and Stakeholder conflicts</li> <li>Wasserressourcenmanagement in urbane Gebieten</li> <li>Rechtliche Aspekte, Organisationsformen Trinkwasserversorgungsunternehmen.</li> <li>Ökobilanzierung, Benchmarking in der Wasserversorgung</li> </ul> </li> </ul>
Literature	<ul> <li>Aktuelle UN World Water Development Reports</li> <li>Branchenbild der deutschen Wasserwirtschaft, VKU (2011)</li> <li>Aktuelle Artikel wissenschaftlicher Zeitschriften</li> <li>Ppt der Vorlesung</li> </ul>

Course L0403: Water Resour	rse 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	
Basics of Coastal Engineering (L08)		Lecture	3	4	
Basics of Coastal Engineering (L14)		Project-/problem-based Learning	1	2	
Module Responsible					
Admission Requirements					
	Basics of hydraulic engineering, hydrology and hydromechanics				
Knowledge					
Educational Objectives	After taking part successfully, students have reached t	ne following learning results			
Professional Competence					
Knowledge	e 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 problems of coastal engineering. Students can define and determine the basics for design ar				
	dimensioning of coastal engineering constructions.				
Skills	The students are capable to apply basic design approaches to selected and pre-defined design tasks in coastal engineering.				
Personal Competence					
Social Competence	e The students are able to deploy their gained knowledge in applied problems such as the design of coastal protection structure				
	Additionaly, they will be able to work in team with engineers of other disciplines, for instance designing of coastal breakwaters.				
Autonomy	The students will be able to independently extend their	knowledge and applyit to new problems			
Autonomy	The students will be able to independently extend then	knowledge and appryit to new 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	nd The duration of the examination is 2 hours. The examination includes tasks with respect to the general understand			understanding of	
scale	lecture contents and calculations tasks.				
Assignment for the	Civil Engineering: Specialisation Structural Engineering	: Elective Compulsory			
•	Civil Engineering: Specialisation Geotechnical Engineering: Compulsory				
	Civil Engineering: Specialisation Coastal Engineering: C	ompulsory			
	International Management and Engineering: Specialisa				

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	DE	
Cycle	WiSe	
Content	<ul> <li>Basics of planning and design <ul> <li>Water levels</li> <li>Currents</li> <li>Waves</li> <li>Ice</li> </ul> </li> <li>Planning and Design in Coastal Engineering <ul> <li>Functional and constructional design</li> <li>Determination of design parameters</li> <li>Design-approaches</li> <li>Filter</li> <li>Rubble mound constructions</li> <li>Piles</li> <li>Vertical constructions</li> </ul> </li> </ul>	
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	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses	
Title	Typ Hrs/wk CP
Integrated Transportation Planning	
Module Responsible	
Admission Requirements	None
Recommended Previous	
Knowledge	some knowledge of danspore planning, e.g. through taking the andergrouddee class "Transpore Hanning and Traine Engineerin
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	After taking part successfully, statents have reached the following rearning results
	Students are able to:
Kilomeage	
	<ul> <li>describe interdependencies between land-use/location choice and transportation/mobility behaviour</li> </ul>
	<ul> <li>explain and evaluate the social, ecological and economic effects of transport and land-use policy measures.</li> </ul>
	<ul> <li>relate current issues in the area of integrated transport planning and formulate an opinion on them.</li> </ul>
Skills	Students are able to:
	<ul> <li>quantify important parameters, which influence travel demand or are influenced by it.</li> </ul>
	<ul> <li>comprehensively examine a pre-defined or self-selected topic from a transportation studies perspective and document t</li> </ul>
	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.
	<ul> <li>produce results in group work and document these.</li> </ul>
Autonomy	Students are able to:
	assess potential consequences of their future professional activities
	<ul> <li>assess potential consequences of their future professional activities</li> <li>independently plan working on a pre-defined project topic, acquire the necessary knowledge and use appropriate means</li> </ul>
	its execution.
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	white a signment with presentation during the sentester
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
•	Civil Engineering: Specialisation Subcedule Engineering: Elective Compulsory
. eening carricula	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
	Civil Engineering: Specialisation Water and Traffic: Compulsory
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective Compulsory
	Water and Environmental Engineering: Specialisation Water: Elective Compulsory
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsory
	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 (2005) Entwicklung innovativer Verkehrsstrategien für die mobile Gesellschaft. Erich Schmidt Verlag. Berlin. Bracher, Tilman u. a. (Hrsg.) (68. Ergänzung 2013) Handbuch der kommunalen Verkehrsplanung. Herbert Wichmann Verlag. Berlin, Offenbach. (Loseblattsammlung mit kontinuierlichen Ergänzungen)

Module M0964: Unde	rground Constructions			
Courses				
Title		Тур	Hrs/wk	СР
Applied Tunnel Constructions (L240	7)	Lecture	2	3
Introduction 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			
<b>Recommended Previous</b>	Modules from Bachelor studies Civil and e	environmental engineering:		
Knowledge				
	Geotechnics I-II			
	Steel Structures I-II			
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge	Knowledge of different tunnel constructiv	on types as well as special methods and techniq	ues of subsoil const	ruction. The studer
	Rhowledge of different tunnel construction types as well as special methods and techniques of subsoil construction. The students get deeper knowledge of steel and ground engineering as well as constructions knowledge concerning guay walls. Futhermore, the			
		dge to design singular construction elements for		
	choose the right construction elements d		·	,
Skills	Basic knowledge of tunnel design as well as practical skills in structural tunnel analysis. Furthermore, the students are able to			
		regarding all constrution elements, to choose		
		design all kinds of sheet pile walls (wave sheet p		
	and to dimension all construction elemen			
Personal Competence				
Social Competence	Capacity for teamwork concerning projec	t management and design of tunnels.		
		vork flow in the framework of a design exercise.		
Workload in Hours	Independent Study Time 124, Study Time	-		
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and	120 minutes			
scale				
Assignment for the	Civil Engineering: Specialisation Structura	al Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotech	nical Engineering: Compulsory		
	Civil Engineering: Specialisation Coastal I	Engineering: Compulsory		
	Civil Engineering: Specialisation Water ar	nd Traffic: 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	Marius Milatz
Language	DE
Cycle	WiSe
Content	<ul> <li>Definitions</li> <li>Historical development in tunneling</li> <li>Geology for tunneling</li> <li>Hard rock tunneling (construction composite and machines)</li> <li>Tunnelung in temporarly stable soil with conventional construction methods</li> <li>Tunneling in soft soils (form of supports, shield types, compressed air application)</li> <li>Pipe jacking</li> <li>Tunnel Lining, tunnel supporting structures</li> <li>Calculation approaches for supporting structures in shield-driven tunnels</li> <li>Surveying for tunneling</li> <li>Safety requirements</li> <li>Construction Contract</li> <li>Literature and sources</li> </ul>
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	Marius Milatz
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

### Module M0969: Selected Topics in Civil Engineering Courses Title Тур Hrs/wk CP 2 Eraonomics (L0653) Lecture 3 Analysis of Offshore Structures (L1867) Lecture 1 1 Excellence in International Project Delivery (L2387) Integrated Lecture 2 2 Design of Prefabricated Concrete Structures (L0596) Lecture 1 1 Design of Prefabricated Concrete Structures (L0597) Recitation Section (large) 1 1 Forum I - Geotechnics and Construction Management (L1634) Seminar 1 1 Forum II - Geotechnics and Construction Management (L1635) Seminar 1 1 2 3 Geotechnical Engineering Design (L2447) Lecture Timber Structures (L1151) Seminar 2 2 Innovative Timber Construction (L2666) Lecture 2 3 Glass Structures (L1152) Lecture 2 2 Glass Structures (L1447) Recitation Section (large) 1 1 Testing and non-destructive examination of concrete members (L2725) Project-/problem-based Learning 2 2 Special topics of civil engineering 1CP (L2378) 1 1 2 Special topics of civil engineering 2 LP (L2379) 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 the following learning results **Professional Competence** Knowledae • 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 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 Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory

Course L0653: Ergonomics	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and	30 min
scale	
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
Content	
Literature	

# Module Manual M.Sc. "Civil Engineering"

Hrs/wk       1         CP       1         Workload In Hours       Independent Study Time 16, Study Time in Lecture 14         Examination Form       Mündliche Prüfung         Examination and       30 min         scale       Difference         Cycle       SoSe         Cycle       SoSe         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 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 6: Tubular Welded Connections, stress concentration factors, weld geometry       Topic 9: Offshore Installation and Exam, installation of structures, pile driving, application of LTI-systems for frequency domain fatige 70 (9: 9: Offshore Installation and Exam, installation of structures, pile driving, application of LTI-systems for frequency domain fatige 70 (9: 9: Offshore Installation and Exam, installation of structures, pile driving, pipe laying techniques         Literature       Chakrabarti, Handbook of Offshore Engineering, 2005         Sarepkaya, Wave Forces on Of	Тур	Lecture
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           Lecturer         Dr. Said Fawad Mohammadi           Cycte         SoSe           Cycte         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 5: Linear-Time-Invariant Systems, response of an LTI-system in frequency domain         Topic 6: Tubular Welded Connections, stress concentration factors, weld geometry           Topic 6: Tubular Welded Connections, stress concentration factors, weld geometry         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, 1998         Sorensen, Basic Coastal Engineering, 2005           Sarpkaya, Wave Forces on Offshore Structures, 1998         Sorensen, Basic Coastal Engineering, 2006           Dowilng, Mechanica	Hrs/wk	1
Examination Form       Mündliche Prüfung         Examination duration and scale       30 min         Iceturer       Dr. Said Fawad Mohammadi         Leturer       Dr. Said Fawad Mohammadi         Cortext       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 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 5: Linear-Time-Invariant Systems, response of an LTI-system in frequency domain         Topic 6: Tubular Welded Connections, stress concentration factors, weld geometry       Topic 9: Introduction to Fracture Mechanics, criteria for fracture initiation and crack growth         Topic 9: Offshore Installation and Exam, installation of structures, pile driving, pipe laying techniques       Literature         Literature       Chakrabarti, Handbook of Offshore Engineering, 2005         Sarpkaya, Wave Forces on Offshore Structures, 1998       Sorensen, Basic Coastal Engineering, 2007         Haibach, Betriebsfestigkeit, 2006       Marshall, Design of Welded Tubular Connections, 1992	СР	1
Examination duration and scale       30 min         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 4: Additional Environmental Forces, wind spectra, current forces         Topic 4: Additional Environmental Forces, wind spectra, current forces       Topic 6: Tubular Welded Connections, stress concentration factors, weld geometry         Topic 6: Tubular Welded Connections, stress concentration factors, weld geometry       Topic 9: Introduction to Fracture Mechanics, criteria for fracture initiation and crack growth         Topic 9: Offshore Installation and Exam, installation of structures, pile driving, pipe laying techniques         Literature       Chakrabarti, Handbook of Offshore Structures, 2010         Faltinsen, Sea Loads on Ships and Offshore Structures, 1998       Sorensen, Basic Coastal Engineering, 2005         Sarpkaya, Wave Forces on Offshore Structures, 1998       Sorensen, Basic Coastal Engineering, 2006         Dowling, Mechanical Behavior of Materials, 2007       Haibach, Betriebsfestigkeit, 2006         Marshall, Design of Welded Tubular Connections, 1992       Marshall, Design of Welded Tubular Connections, 1992	Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
scale         Lecture       Dr. Said Fawad Mohammadi         Language       DE/EN         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 5: Linear-Time-Invariant Systems, response of an LTI-system in frequency domain       Topic 6: Tubular Welded Connections, stress concentration factors, weld geometry         Topic 1: Introduction to Fracture Mechanics, criteria for fracture initiation and crack growth       Topic 9: Offshore Installation and Exam, installation of structures, pile driving, pipe laying techniques         Literature       Chakrabarti, Handbook of 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       Marshall, Design of Welded Tubular Connections, 1992	Examination Form	Mündliche Prüfung
Lecturer         Dr. Sald 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 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 fatige           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		30 min
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 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 9: Offshore Installation and Exam, installation of structures, pile driving, application of LTI-systems for frequency domain fatige           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		
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 9: Offshore Installation and Exam, installation of structures, pile driving, pipe laying techniques       Literature         Chakrabartii, 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		
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Dowling, Mechanical Behavior of Materials, 2007 Haibach, Betriebsfestigkeit, 2006 Marshall, Design of Welded Tubular Connections, 1992		Faltinsen, Sea Loads on Ships and Offshore Structures, 1998
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Marshall, Design of Welded Tubular Connections, 1992		Dowling, Mechanical Behavior of Materials, 2007
		Haibach, Betriebsfestigkeit, 2006
Newland, Random vibrations, spectral and wavelet analysis, 1993		Marshall, Design of Welded Tubular Connections, 1992
		Newland, Random vibrations, spectral and wavelet analysis, 1993

Course L2387: Excellence in	Course L2387: Excellence in International Project Delivery		
Тур	Integrated Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Examination Form	laut FSPO		
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt		
scale			
Lecturer	Dr. Jens Huckfeldt		
Language	EN		
Cycle	SoSe		
Content			
Literature			

Course L0596: Design of Pre	fabricated Concrete Structures
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and	60 min
scale	
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	<ul> <li>application and advantages and disadvantages of precast concrete structures</li> <li>basics of design - precast element production - construction - tolerances</li> <li>elements of a warehouse</li> <li>design of a beam - joints</li> <li>design of D-regions: half joints, corbels, openings</li> <li>slab types - walls - facades</li> <li>footings: pocket and block foundations</li> <li>joints - connections</li> <li>shear design of the interface between concrete cast at different times</li> <li>unreinforced concrete structures</li> </ul>
Literature	<ul> <li>Bachmann H., Steinle A.; Hahn V.: Bauen mit Betonfertigteilen. Betonkalender 2009, Teil I, Verlag Ernst &amp; Sohn, Berlin</li> <li>Bindseil P.: Stahlbetonfertigteile. Werner Verlag, 1998</li> <li>FIP: FIP Handbuch für Planung und Entwerfen von Fertigteilbauten (siehe Zeitschrift: Beton- und Fertigteiltechnik ab 3/1996)</li> <li>Bergmeister K.: Konstruieren von Fertigteilen. Betonkalender 2005 Teil 2, S. 163-240</li> <li>Reineck KH.: Modellierung der D-Bereiche von Fertigteilen. Betonkalender 2005 Teil 2, S. 241-296</li> <li>Graubner CA. et. al.: Bemessung von Fertigteilen nach DIN 1045-1. Betonkalender 2005 Teil 2, S. 297-374</li> </ul> Broschüren der Fachvereinigung Deutscher Betonfertigteilbau e.V. siehe: www.fdb-fertigteilbau.de <ul> <li>www.systembauweise.de</li> </ul>

Course L0597: Design of Prefabricated Concrete Structures	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and	Siehe korrespondierende Vorlesung
scale	
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

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	ourse 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 L2447: Geotechnical	Engineering Design
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and	45 Min.
scale	
Lecturer	Prof. Jürgen Grabe, Dr. Tim Pucker
Language	DE
Cycle	WiSe
Content	The focus of the course is on the design of geotechnical structures. Methods and fundamental approaches for the successful processing of geotechnical designs are taught. Theoretical approaches are backed up with examples from everyday work in industry. In parallel to the theoretical content, students are given a practical task for a geotechnical design at beginning of the course, which will be worked on in small teams. In addition to the application of the already acquired technical knowledge, topics like realisation, construction sequence planning, cost calculation, optimisation and evaluation criteria are also part of the course. The event will be finished with the presentation of the designs.
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 Tir	nber Construction
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, 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	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	ourse 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 L2725: Testing and non-destructive examination of concrete members	
Тур	Project-/problem-based Learning
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	Prof. Günter Rombach, Dr. Lukas Henze
Language	DE
Cycle	SoSe
Content	
Literature	

Course L2378: Special topics	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	laut FSPO	
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	laut FSPO
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	laut FSPO
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.

# Module Manual M.Sc. "Civil Engineering"

Course 12780, Structure 1 Day	
Course L2789: Structural Des	
	Seminar
Hrs/wk	
СР	
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
<b>Recommended Previous</b>	Subjects of the Structural 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 structural and construction engineering. They construction engineering and application and discuss critically in the context of actual problems and general conditions science and society.
	The students can develop solving strategies and approaches for fundamental and practical problems in structural and constructivengineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view point 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 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 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 scale	see FSPO
	Civil Engineering: Specialisation Structural Engineering: Compulsory

Courses				
Title		Тур	Hrs/wk	СР
Plates and Shells (L1199)		Lecture	2	2
Nonlinear Analysis of Frame Struct	ure (L1200)	Lecture	2	2
Nonlinear Analysis of Frame Struct	ure (L1201)	Recitation Section (large)	2	2
Module Responsible	Prof. Uwe Starossek			
Admission Requirements	None			
<b>Recommended Previous</b>	Mechanics I/II, Mathematics I/II, Differe	ntial Equations I		
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge	After successful completion of this mod	dule, students can explain selected elements of high	er structural analys	is.
Skills				
56115				
	After successful completion of this mo	odule, the students are able to assess the premise	s and the applicabi	lity of the presen
	methods of advanced structural analys	is. They are able to use these methods for performing	ng structural analys	es.
	· · · · · · · · · · · · · · · · · · ·		<u> </u>	
Personal Competence				
Social Competence	Students can			
		and the state of t		
	participate in subject-specific an			
	defend their own work results in			
	<ul> <li>promote the scientific developm</li> </ul>	•		
	<ul> <li>Furthermore, they can give and</li> </ul>	accept professional constructive criticism		
Autonomy	The students have the encertupity to y	roluntarily and independently work homework proble	226	
Autonomy	The students have the opportunity to v	oluntarily and independently work nonework proble	:115.	
Workload in Hours	Independent Study Time 96, Study Tim	ne in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	135 min			
scale				
	Civil Engineering: Specialisation Struct	ural Engineering: Elective Compulsory		
Assignment for the	civil Engineering. Specialisation Stract	and Engineering: Elective compaisony		
Assignment for the Following Curricula		chnical Engineering: Elective Compulsory		

Tun	Lecture		
Hrs/wk			
CP			
	Independent Study Time 32, Study Time in Lecture 28		
	Dr. Jürgen Priebe		
Language			
	WiSe		
Content	Theory of 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		
	Theory of plates in bending		
	Governing equations (equilibrium, kinematics, constitutive law)		
	Differential equation		
	Navier solution / Fourier series expansion		
	Approximation procedures		
	Structural behaviour of plates in bending		
	Shell theory		
	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		
	Stability problems (overview)		
	Plate buckling		
	Shell buckling		
Literature			
	<ul> <li>Basar, Y.: Krätzig, W.B. (1985): Mechanik der Flächentragwerke. Vieweg-Verlag, Braunschweig, Wiesbaden</li> <li>Girkmann, K. (1963): Flächentragwerke, Springer Verlag, Wien, 1963, unveränderter Nachdruck 1986</li> </ul>		
	<ul> <li>Girkmann, K. (1903): Flachentragwerke, Springer Vehag, wien, 1905, unveranderter Nachdruck 1906</li> <li>Zienkiewicz, O.C. (1977): The Finite Element Method in Enginieering Science. McGraw-Hill, London</li> </ul>		
	<ul> <li>Zienkewicz, o.e. (2077). The Finite Element Method in Engineering Science. McGraw-Hill, E010011</li> </ul>		

Course L1200: Nonlinear Ana	alysis of Frame Structure
	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	WiSe
Content	-Types of nonlinearity
	-relevance of nonlinear effects on structural analysis
	-comparison and classification of 1 <sup>st</sup> order theory, 2 <sup>nd</sup> order theory and 3 <sup>rd</sup> order theory with regard to the coverage of geometric nonlinearity
	-fundamentals of 2 <sup>nd</sup> order elasticity theory for frame structures
	-application of 2 <sup>nd</sup> order elasticity theory using finite elements: common displacement method
	-fundamentals of analytical application of 2 <sup>nd</sup> order elasticity theory: derivation and solution of differential equation
	-structurally applied methods of analytical application of 2 <sup>nd</sup> order elasticity theory: common displacement method using analytical stiffness matrix, slope-deflection method for sway and non-sway frame structures, consideration of imperfections
	1 <sup>st</sup> order plastic hinge theory
Literature	Rothert, H.; Gensichen, V. (1987): Nichtlineare Stabstatik. Springer Verlag, Berlin

Course L1201: Nonlinear Ana	ourse L1201: Nonlinear Analysis of Frame Structure		
Тур	itation Section (large)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Uwe Starossek		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses				
Title		Тур	Hrs/wk	СР
Scientific Working in Computationa	I Engineering (L2764)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
<b>Recommended Previous</b>	Basic knowledge in scientific writing. Strin	Basic knowledge in scientific writing. String interest in topics related to computing in civil engineering.		
Knowledge				
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
	thinking, being able to accurately plan, implement and analyze scientific projects, such as prospective master theses. Sin scientific writing is of particular importance in this course, a scientific paper will be developed, which is a prerequisite for the fi examination. The paper will be written based on a project to be conducted within this course. Project meetings in small group presentations, and critical discussions of scientific publications are further key activities.			
Skills				
Personal Competence				
Social Competence				
Autonomy				
	Independent Study Time 124, Study Time	in Lecture 56		
Credit points				
Course achievement				
	Written elaboration			
	10 pages of work with 15-minute oral pres	sentation		
scale				
Assignment for the	Civil Engineering: Specialisation Water an			
Assignment for the	Civil Engineering: Specialisation Water an Civil Engineering: Specialisation Geotechr Civil Engineering: Specialisation Coastal E	ical Engineering: 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	

Courses	
<b>Title</b> 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	None
Recommended Previous Knowledge	Hydrology Hydraulic Engineering
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence Knowledge Skills	<ul> <li>Climate protection and climate adaptation</li> <li>Insights into climate change and its regional characteristics - fundamentals, climate modelling / climate models</li> <li>Impacts of climate change on the components of the regional hydrological cycle</li> <li>Fundamentals of analysis of climate data</li> <li>Consequences of the impact of the climate change</li> <li>Measures for climate adaptation</li> <li>Assessment, prioritization and communication of adaptation measures</li> <li>Fundamentals of the analysis of hydrometeorological and hydrological data</li> </ul>
Personal Competence Social Competence Autonomy	<ul> <li>Working in heterogenous groups</li> <li>Working with different scientific / non-scientific disciplines</li> <li>Self reflection</li> </ul>
	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
scale	Preparation of a written report and a presentation of a complex task.
Assignment for the Following Curricula	
. ee ming carricula	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	<ul> <li>Climate protection and climate adaptation</li> <li>Findings on climate change and its regional characteristics: fundamentals of climate change, climate modelling / climate models</li> <li>Impacts of climate change on the components of the regional hydrological cycle(climate science view)</li> <li>Fundamentals of the analysis of climate data</li> <li>Concequences of the impacts of climate change (ingenieering science view)</li> <li>Measures for climate change adaptation</li> <li>Assessment, prioritization and communication of measures</li> <li>Fundamentals of analysis of hydrometeorological and hydrological data</li> </ul>
Literature	Bereitgestellte eLearning Plattform

# **Specialization Water and Traffic**

## Module M1437: Non destructive testing of materials and parts Courses Title Тур Hrs/wk СР Non destructive testing of materials and parts (L2215) Lecture 2 2 3 Non destructive testing of materials and parts (L2217) Project-/problem-based Learning 3 Non destructive testing of materials and parts (L2216) Recitation Section (large) 1 1 Module Responsible Prof. Bodo Fiedler **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 96, Study Time in Lecture 84 Credit points 6 **Course achievement** None Examination Written elaboration Examination duration and Written document about theory and praxis scale Assignment for the Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Following Curricula Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Materials Science: Specialisation Engineering Materials: Elective Compulsory

	ve testing of materials and parts Lecture
Hrs/wk	
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Robert Meißner, Prof. Marcus Rutner
Language	DE/EN
Cycle	WiSe
Content	This strongly interdisciplinary lecture and practical course is offered to Masterstudents who are interesed to learn about ar
	important field across engineering and material science industries, i.e. nondestructive testing of materials and parts
	Interdisciplinary approaches and thinking becomes more and more important since many problems extend into various disciplines
	hence, can only be solved through interdisciplinary thinking and collaboration. Accordingly, this module combines the efforts of 4
	different disciplines, i.e. mechanical engineering, civil engineering, materials science and computer science with a touch of
	electrical engineering. Nondestructive testing (NDT) is the process of inspecting, testing, and evaluating materials, parts, and
	assemblies to understand properties and defects without causing damage to the material or part. This scientific approach enables
to make intrinsic material and component characteristics visible. Hence, the approach links detection approaches (e.g. line	
	nonlinear acoustic methods, ultrasonic testing, Magnetic Particle Testing, thermo-chemical methods, etc.) with material physics
	and the mechanics of components, further, with evaluation, interpretation, big data management, transmission of data, and
	cybersecurity. The module embraces a lecture and a practical course. Contents of the lecture are NTD technologies and thei
	theory behind, evaluation, transmission of data, while the students will apply the NDT technologies during the practical course in
	the experimental test halls and labs at TUHH. Lecture and practical course split into the major themes: A) Detection: Theory and
	Practice B) Evaluation of Data: Theory and Practice C) Data Acquisition and Transmission with Wireless, Batteryless Sensor
	Devices:Theory and Practice
Literature	

Course L2217: Non destructi	urse L2217: Non destructive testing of materials and parts		
Тур	Project-/problem-based Learning		
Hrs/wk	3		
СР	3		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Robert Meißner, Prof. Marcus Rutner		
Language	DE/EN		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L2216: Non destructi	ve testing of materials and parts
Тур	Recitation Section (large)
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Bodo Fiedler, Prof. Bernd-Christian Renner, Prof. Robert Meißner, Prof. Marcus Rutner
Language	DE/EN
Cycle	WiSe
Content	This strongly interdisciplinary lecture and practical course is offered to Masterstudents who are interesed to learn about an
	important field across engineering and material science industries, i.e. nondestructive testing of materials and parts.
	Interdisciplinary approaches and thinking becomes more and more important since many problems extend into various disciplines,
	hence, can only be solved through interdisciplinary thinking and collaboration. Accordingly, this module combines the efforts of 4
	different disciplines, i.e. mechanical engineering, civil engineering, materials science and computer science with a touch of
	electrical engineering. Nondestructive testing (NDT) is the process of inspecting, testing, and evaluating materials, parts, and
	assemblies to understand properties and defects without causing damage to the material or part. This scientific approach enables
	to make intrinsic material and component characteristics visible. Hence, the approach links detection approaches (e.g. linear and
	nonlinear acoustic methods, ultrasonic testing, Magnetic Particle Testing, thermo-chemical methods, etc.) with material physics
	and the mechanics of components, further, with evaluation, interpretation, big data management, transmission of data, and
	cybersecurity. The module embraces a lecture and a practical course. Contents of the lecture are NTD technologies and their
	theory behind, evaluation, transmission of data, while the students will apply the NDT technologies during the practical course in
	the experimental test halls and labs at TUHH. Lecture and practical course split into the major themes: A) Detection: Theory and
	Practice B) Evaluation of Data: Theory and Practice C) Data Acquisition and Transmission with Wireless, Batteryless Sensor
	Devices:Theory and Practice
Literature	

Module M0964: Under	ground Constructions				
Hodale Hoso Honae	ground constructions				
Courses					
Title		Тур	Hrs/wk	СР	
Applied Tunnel Constructions (L240	7)	Lecture	2	3	
Introduction 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				
<b>Recommended Previous</b>	Modules from Bachelor studies Civil and e	nvironmental engineering:			
Knowledge					
	Geotechnics I-II				
	Steel Structures I-II				
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results			
Professional Competence					
Knowledge	Knowledge of different tunnel constructio	n types as well as special methods and techniqu	ues of subsoil const	ruction. The studer	
	get deeper knowledge of steel and ground engineering as well as constructions knowledge concerning quay walls. Futhermore, th				
	students get all the neccessary knowledge to design singular construction elements for sheet pile walls and they know how				
	choose the right construction elements de	epending on the influencing conditions.	·		
Skills	s Basic knowledge of tunnel design as well as practical skills in structural tunnel analysis. Furthermore, the students are able t				
	dimension sheet pile wall construction regarding all construction elements, to choose the suitable construction elements with				
			of sheet pile walls (wave sheet pile walls and combined sheet pile wall		
	and to dimension all construction element				
Personal Competence					
	Capacity for teamwork concerning project	management and design of tunnels.			
Autonomy		ork flow in the framework of a design exercise.			
Workload in Hours	Independent Study Time 124, Study Time	÷			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	120 minutes				
scale					
Assignment for the	Civil Engineering: Specialisation Structura	I Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechr	nical Engineering: Compulsory			
	Civil Engineering: Specialisation Coastal E	ngineering: Compulsory			
	Civil Engineering: Specialisation Water an	d Traffic: Elective Compulsory			
	International Management and Engineerin	a Creciplication II. Civil Engineering, Elective Co	manulcon		

Course L2407: Applied Tunnel Constructions	
Тур	Lecture
Hrs/wk	2
CP	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	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Marius Milatz	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Definitions</li> <li>Historical development in tunneling</li> <li>Geology for tunneling</li> <li>Hard rock tunneling (construction composite and machines)</li> <li>Tunnelung in temporarly stable soil with conventional construction methods</li> <li>Tunneling in soft soils (form of supports, shield types, compressed air application)</li> <li>Pipe jacking</li> <li>Tunnel Lining, tunnel supporting structures</li> <li>Calculation approaches for supporting structures in shield-driven tunnels</li> <li>Surveying for tunneling</li> <li>Safety requirements</li> <li>Construction Contract</li> <li>Literature and sources</li> </ul>	
Literature	<ul> <li>Vorlesung/Übung s. www.tu-harburg.de/gbt</li> </ul>	

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	Marius Milatz	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses				
Title		Тур	Hrs/wk	СР
Examination of Materials, Structura	al Condition and Damages (L0260)	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			
<b>Recommended Previous</b>	Basic knowledge about building materials or m	aterial science, for example by the mo	dule Building Ma	aterials and Build
Knowledge	Chemistry.			
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
<b>Professional Competence</b>				
Knowledge	The students are able to describe the rules for tr	ading, use and marking of construction pr	oducts in Germar	ny. They know whi
	methods for the testing of building material prope	rties are usable and know the limitations a	nd characterics o	f the most import
	testing methods.			
Chille	The students are able to responsibly discover the	allos for trading and using of building prod	usta in Cormony	
SKIIIS	The students are able to responsibly discover the i			tion of domograp
	They are able to chose suitable methods for the to			
	the examination of the structural conditions of bui are able to describe an examination in form of a t		nptons to the cau	se of damages. If
Personal Competence				
Social Competence	The students can describe the different roles of r	nanufacturers as well as testing, supervise	ory and certificati	on bodies within
	framework of material testing. They can describe t	he different roles of the participants in leg	al proceedings.	
Autonomy	The students are able to make the timing and the	operation steps to learn the specialist know	vledge of a very e	extensive field.
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Enginee	ering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engi	neering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering	ng: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory		
	International Management and Engineering: Speci	alisation II. Civil Engineering: Elective Com	oulsory	
	Materials Science: Specialisation Engineering Mate	rials: Elective Compulsory		

# Course L0260: Examination of Materials, Structural Condition and Damages Typ Lecture Lecture 3 CP 4 Workload in Hours Independent Study Time 78, Study Time in Lecture 42 Lecturer Prof. Frank Schmidt-Döhl Language DE 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	
Title	Typ Hrs/wk CP
Integrated Transportation Planning	
Module Responsible	Prof. Carsten Gertz
Admission Requirements	None
<b>Recommended Previous</b>	some knowledge of transport planning, e.g. through taking the undergraduate class "Transport Planning and Traffic Engineerin
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	Students are able to:
	<ul> <li>describe interdependencies between land-use/location choice and transportation/mobility behaviour</li> <li>explain and evaluate the social, ecological and economic effects of transport and land-use policy measures.</li> <li>relate current issues in the area of integrated transport planning and formulate an opinion on them.</li> </ul>
Skills	Students are able to:
	<ul> <li>quantify important parameters, which influence travel demand or are influenced by it.</li> <li>comprehensively examine a pre-defined or self-selected topic from a transportation studies perspective and document results in accordance with scientific conventions.</li> </ul>
Personal Competence	
Social Competence	Students are able to:
	<ul> <li>provide feedback on topical contents and their teaching.</li> </ul>
	constructively handle feedback on their own work.
	<ul> <li>produce results in group work and document these.</li> </ul>
Autonomy	Students are able to:
	assess potential consequences of their future professional activities
	<ul> <li>independently plan working on a pre-defined project topic, acquire the necessary knowledge and use appropriate means its execution.</li> </ul>
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	
	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 Compulsory
	Water and Environmental Engineering: Specialisation Water: Elective Compulsory
	Water and Environmental Engineering: Specialisation Environment: Elective 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.:
Literature	Kutter, Eckhard (2005) Entwicklung innovativer Verkehrsstrategien für die mobile Gesellschaft. Erich Schmidt Verlag. Berlin. Bracher, Tilman u. a. (Hrsg.) (68. Ergänzung 2013) 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 Treatment (L0312)		Recitation Section (large)	1	2
Water Resource Management (L04		Lecture	2	2
Water Resource Management (L04		Recitation Section (small)	1	1
Module Responsible				
Admission Requirements	None			
	Knowledge of water management and th	e key processes involved in water treatment.		
Knowledge		and the state of the state of the state of the state of the		
-	After taking part successfully, students h	ave reached the following learning results		
Professional Competence		as of conflict in water management, as well as		
Skills	outline the organisational structures of water companies. They will be able to explain the available water treatment processes an the scope of their application. 5 Students will be able to assess complex problems in drinking water production and establish solutions involving water management and technical measures. They will be able to assess the evaluation methods that can be used for this. Students wi			
Personal Competence Social Competence	be able to carry out chemical calculations for selected treatment processes and apply generally accepted technical rules ar standards to these processes. Working in a diverse group of specialists, students will be able to develop and document complex solutions for the management and treatment of drinking water. They will be able to take an appropriate professional position, for example representing use			
Autonomy		nt solutions in teams of diverse experts and pres a subject independently and present on this subj		o otners.
Werkland in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points				
Course achievement				
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			
	Civil Engineering: Specialisation Water a			
	Civil Engineering: Specialisation Coastal			
		Specialisation Energy and Environmental Engine	ering: Elective Comp	ulsorv
	•••	ng: Specialisation II. Energy and Environmental	•	-
		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	<ul> <li>MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John Wiley &amp; Sons, Hoboken, 2005.</li> <li>Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley &amp; Sons, New York, 1996.</li> <li>DVGW (Hrsg.): Wasseraufbereitung - Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004.</li> <li>Jensen, J. N.: A Problem Solving Approach to Aquatic Chemistry. John Wiley &amp; Sons, Inc., New York, 2003.</li> </ul>

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	<ul> <li>Aktuelle UN World Water Development Reports</li> <li>Branchenbild der deutschen Wasserwirtschaft, VKU (2011)</li> <li>Aktuelle Artikel wissenschaftlicher Zeitschriften</li> <li>Ppt der Vorlesung</li> </ul>

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
Integrated Pollution Control (L0502	)	Lecture	2	2
Health, Safety and Environmental Management (L0387)		Lecture	2	3
Health, Safety and Environmental	Management (L0388)	Recitation Section (small)	1	1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
<b>Recommended Previous</b>	· Cood lucauladas in Tachaslasias far Fru	in a second a local second		
<ul> <li>Good knowledge in Technologies for Environmental Protection (end-of-pipe, integrated so</li> <li>Good knowledge of the relevant Environmental Legislation</li> </ul>			ted solutions)	
	Good knowledge of the relevant Environmental Legislation     Basic knowledge of instruments for Environmental Assessment			
Educational Objectives	After taking part successfully, students have re	ached the following learning results		
Professional Competence				
Knowledge	The students are able to describe the basics	of regulations, economic instruments, vo	luntary initiatives, f	undamentals of H
	legislation ISO 14001, EMAS and Responsible	Care ISO 14001 requirements. They can a	nalyse and discuss	industrial process
	substance cycles and approaches from end-	of-pipe technology to eco-efficiency and	eco-effectiveness, s	showing their sou
	knowledge of complex industry related proble	ms. They are able to judge environmenta	issues and to wide	ly consider, apply
	carry out innovative technical solutions, reme		s as well as concept	tual problem solv
	approaches in the full range of problems in diffe	erent industrial sectors.		
Skills	Students are able to assess current problems	and situations in the field of environmenta	al protection. They c	an consider the b
	available techniques and to plan and suggest		specific context. By	this means they
	solve problems on a technical, administrative a	nd legislative level.		
Personal Competence				
Social Competence	e The students can work together in international groups.			
Autonomy	Students are able to organize their work flow t		nd contributions to t	he discussions. T
	can acquire appropriate knowledge by making	enquiries independently.		
Workload in Hours Credit points	Independent Study Time 110, Study Time in Le	cture 70		
Course achievement				
Examination	Written exam			
Examination duration and	90 min			
scale				
	Civil Engineering: Specialisation Water and Traf	ffic: Elective Compulsory		
Following Curricula			Management and	Controlling: Elect
-	Compulsory			-
	Energy and Environmental Engineering: Special	lisation Environmental Engineering: Electiv	e Compulsory	
	Environmental Engineering: Core qualification:	Compulsory		
	Joint European Master in Environmental Studies	- Cities and Sustainability: Specialisation	Nater: Elective Comp	oulsory
	Joint European Master in Environmental Studies	- Cities and Sustainability: Specialisation I	Energy: Elective Com	pulsory
	Product Development, Materials and Production	n: Specialisation Product Development: Elec	tive Compulsory	
	Product Development, Materials and Production	n: Specialisation Production: Elective Comp	ulsory	
	Product Development, Materials and Production	n: Specialisation Materials: Elective Compu	sory	
	Process Engineering: Specialisation Environmer	ntal Process Engineering: Elective Compuls	ory	
	Water and Environmental Engineering: Speciali Water and Environmental Engineering: Speciali			

Course L0387: Health, Safety	y and Environmental Management
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Hans-Joachim Nau
Language	EN
Cycle	WiSe
Content	<ul> <li>Objectives of and benefit from HSE management</li> <li>From dilution and end-of-pipe technology to eco-efficiency and eco-effectiveness Behaviour control: regulations, economic instruments and voluntary initiatives</li> <li>Fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements Environmental performance evaluation Risk management: hazard, risk and safety Health and safety at the workplace</li> <li>Crisis management</li> </ul>
Literature	C. Stephan: Industrial Health, Safety and Environmental Management, MV-Verlag, Münster, 2007/2012 (can be found in the library under GTG 315) Exercises can be downloaded from StudIP

Course L0388: Health, Safety and Environmental Management	
Тур	Recitation Section (small)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Hans-Joachim Nau
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Courses				
Title		Тур	Hrs/wk	СР
Biological Wastewater Treatment (I	0517)	Lecture	2	3
Air Pollution Abatement (L0203)		Lecture	2	3
Module Responsible	Dr. Swantje Pietsch			
Admission Requirements	None			
<b>Recommended Previous</b>	Basic knowledge of biology and chemistry	/		
Knowledge				
	Basic knowledge of solids process engine	ering and separation technology		
Educational Objections				
	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge	After successful completion of the module	e students are able to		
	<ul> <li>name and explain biological process</li> </ul>	sses for waste water treatment,		
	<ul> <li>characterize waste water and sewa</li> </ul>	age sludge,		
	<ul> <li>discuss legal regulations in the are</li> </ul>	a of emissions and air quality		
	<ul> <li>explain the effects of air pollutants</li> </ul>	on the environment,		
	<ul> <li>name and explan off gas tretamen</li> </ul>	t processes and to define their area of applic	ation	
Skills	Students are able to			
SKIIS				
	<ul> <li>choose and design processs steps</li> </ul>	for the biological waste water treatment		
	combine processes for cleaning of	off-gases depending on the pollutants contai	ned in the gases	
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Water an	d Traffic: Elective Compulsory		
Following Curricula	Bioprocess Engineering: Specialisation A	- General Bioprocess Engineering: Elective Co	ompulsory	
	Chemical and Bioprocess Engineering: Sp	ecialisation General Process Engineering: Ele	ective Compulsory	
	Energy and Environmental Engineering: S	pecialisation Environmental Engineering: Ele	ective Compulsory	
	Environmental Engineering: Specialisation	n Waste and Energy: Elective Compulsory		
	International Management and Engineering	ng: Specialisation II. Energy and Environment	tal Engineering: Elective (	Compulsory
	Joint European Master in Environmental S	tudies - Cities and Sustainability: Specialisat	ion Water: Elective Comp	ulsory
	Renewable Energies: Specialisation Bioen	ergy Systems: Elective Compulsory		
	Process Engineering: Specialisation Enviro	onmental Process Engineering: Elective Com	pulsory	
	Process Engineering: Specialisation Proce	ss Engineering: Elective Compulsory		
	Water and Environmental Engineering: Sp	pecialisation Water: Elective Compulsory		
	Water and Environmental Engineering: Sp	pecialisation Environment: Compulsory		
	Water and Environmental Engineering: Sp	acialisation Cities: Compulsory		

Course L0517: Biological Wastewater Treatment		
Тур	Lecture	
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	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 L0203: Air Pollution A	Abatement
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Swantje Pietsch
Language	EN
Cycle	WiSe
Content	In the lecture methods for the reduction of emissions from industrial plants are treated. At the beginning a short survey of the different forms of air pollutants is given. In the second part physical principals for the removal of particulate and gaseous pollutants form flue gases are treated. Industrial applications of these principles are demonstrated with examples showing the removal of specific compounds, e.g. sulfur or mercury from flue gases of incinerators.
Literature	Handbook of air pollution prevention and control, Nicholas P. Cheremisinoff Amsterdam [u.a.] : Butterworth-Heinemann, 2002 Atmospheric pollution : history, science, and regulation, Mark Zachary Jacobson Cambridge [u.a.] : Cambridge Univ. Press, 2002 Air pollution control technology handbook, Karl B. Schnelle Boca Raton [u.a.] : CRC Press, c 2002 Air pollution, Jeremy Colls 2. ed London [u.a.] : Spon, 2002

Courses				
Title		Тур	Hrs/wk	СР
Biology (L1428)		Lecture	2	2
Geology and Soil Science (L0903)		Lecture	2	1
Environmental Analysis (L0354)		Lecture	2	3
	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
<b>Recommended Previous</b>	Fundamentals of inorganic/organic	chemistry and biology (knowledge acquired at sch	nool)	
Knowledge				
Educational Objectives	After taking part successfully, stude	ents have reached the following learning results		
<b>Professional Competence</b>				
Knowledge	With the completion of this module students acquire profound knowledge of the geo- and pedosphere, biogeochemical proces			
	and the fate of migrating compound	ds in soil and groundwater. They learn about meth	ods to investigate sites f	or different use.
Skille	With the completion of this module	e students can apply the acquired theoretical know	uladaa ta madal sitas an	d accord the citual
SKIIIS		y are able to draw comparisons on different inv	5	
	projects can be devised and treated		restigation strategies an	iu techniques. Mo
	projects can be devised and treated	u.		
Personal Competence				
Social Competence	Students can discuss technical and	scientific tasks within a seminar subject specific a	nd interdisciplinary .	
A 4		and the second		
Αυτοποτηγ	Students can independently exploit	sources , acquire the particular knowledge of the	subject and apply it to n	ew problems.
Workload in Hours	Independent Study Time 96, Study	Time in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	2 Std. 15 Min.			
scale				
Assignment for the	Civil Engineering: Specialisation Wa	ater and Traffic: Elective Compulsory		
Following Curricula	Water and Environmental Engineer	ing, Coro qualification, Compulson,		

ourse L1428: Biology		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Anna Krüger, Prof. Garabed Antranikian	
Language	EN	
Cycle	WiSe	
Content		
Literature	Umweltmikrobiologie, Reineke, W. und Schlömann, M. (2015) 2. Aufl., Springer Spektrum Verlag	

Course L0903: Geology and S	Soil Science
Тур	Lecture
Hrs/wk	2
СР	1
Workload in Hours	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Joachim Gerth, Sonja Götz
Language	DE
Cycle	WiSe
Content	Geology: formation of the Earth, plate tectonics, macroscopic rock identification, introduction to Earth history, introduction to halokinesis. Soil science: soil use and function in ecosystems, faktors and processes of soil formation, mineral and organic components, surface types and properties, retention of nutrients and pollutants, hazards from faulty land use, erosion, salinization, and contamination, measures to preserve soils
Literature	R. Vinx (2011): "Gesteinsbestimmung im Gelände" H. Bahlburg & C. Breitkreutz (2012): "Grundlagen der Geologie", TUB Signatur GWB-318 R. Walter (2003): "Ergeschichte" TUB Signatur: 2816-1769 F.Scheffer und P. Schachtschabel (2002): "Lehrbuch der Bodenkunde" TUB Signatur AGG-308 W.E.H. Blum (2007): "Bodenkunde in Stichworten" TUB Signatur AGG-317

Course L0354: Environmenta	I Analysis
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Dorothea Rechtenbach, Dr. Henning Mangels
Language	EN
	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 Emission
	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)

Courses				
		-	11	
Title Construction and renovation of urban sewer systems (L1998)		<b>Typ</b> Seminar	Hrs/wk	<b>CP</b> 3
Simulation of sewerage systems (L2006)		Seminar	3	3
Module Responsible		Jennia	5	5
Admission Requirements				
Recommended Previous	None			
Knowledge	<ul> <li>Hydraulics in pipes and gravity-set</li> </ul>	ewers		
Knowledge	Mechanics			
	<ul> <li>Soil mechanics and foundation en</li> </ul>	gineering		
	Knowledge about urban sewerage	e systems and water management		
Educational Objectives	After taking part successfully, students l	have reached the following learning results		
Professional Competence				
-	Students can describe urban wastewate	r systems by means of software-based modeli	ing In case studies the	con porform syste
Kilowiedge				
	and weak point analyzes. In addition, they can analyze the hydraulic effects quantitatively. Furthermore, they have the knowledge to comprehend flow events in gravity-sewers based on the St. Venant equations.			
	to comprehend now events in gravity-se	ewers based on the St. Venant equations.		
	Students have knowledge of static and structural requirements of the sewer system. Cases of damage are investigated and the			
	knowledge regarding different renovatio	n technologies for sewer systems is acquired.		
Skills	s The students can simulate different run-off events in sewer systems and are able to dimension the sewer systems according			
	Moreover, they can determine suitable construction materials and static requirements for different cases of application.			
Personal Competence				
Social Competence	Students are able to apply the acquired	skills in a team and can impart this knowledge	2.	
Autonomy		ïeld of wastewater systems independently,	•	ar dimensioning a
	simulation of sewer systems. Furthermore, they are able to present and justify their solutions.			
Workload in Hours	Independent Study Time 96, Study Time	e in Lecture 84		
Credit points	6			
Course achievement	Compulsory Bonus Form	Description		
	No 20 % Presentation			
Examination	Written elaboration			
Examination duration and	nach Absprache			
scale				
Assignment for the	Civil Engineering: Specialisation Water a	nd Traffic: Compulsory		
Following Curricula	Water and Environmental Engineering: Specialisation Water: Compulsory			
-				

Course L1998: Construction a	and renovation of urban sewer systems	
Тур	Seminar	
Hrs/wk		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Ingo Weidlich	
Language		
Cycle	WiSe	
Content	The lecture focusses on construction and renovation of urban se	wer pipelines.
	Construction:	
	<ul><li>Pipe materials, types and joint technology</li><li>Open trenches</li></ul>	
	Trenchless technologies	
	• Treffeniciss technologics	
	Pipe Statics:	
	• Design of sewers according to ATV A 127	
	<ul> <li>Earth pressure on pipes, pipe deformation, cutting forces</li> </ul>	
	Comparison with other international calculation approach	es
	Renovation:	
	Failure case study	
	Overview on the different renovation technologies	
	Liner design according to DWA-A 143	
Literature	Nir	Titel
Literature	1	ATV A 127, Abwassertechnische Vereinigung e.V., Arbeitsblatt A
	1	127, Regelwerk Abwasser-Abfall, Vertrieb: GFA, DK 628.22
		(083),A 127, 2000
	2	DIN EN 1610, Verlegung und Prüfung von Abwasserleitungen und
		-kanälen, Beuth Verlag, Berlin, 1997
	3	Arbeitsblatt DWA-A 143-1, Sanierung von
		Entwässerungssystemen außerhalb von Gebäuden, Teil 1:
		Planung und Überwachung von Sanierungsmaßnahmen Februar
		2015
	4	Arbeitsblatt DWA-A 143-2, Sanierung von
		Entwässerungssystemen außerhalb von Gebäuden Teil 2:
		Statische Berechnung zur Sanierung von Abwasserleitungen und
	5	-kanälen mit Lining und Montageverfahren, Juli 2015 DIN EN 752:2008, 2008: Entwässerungssysteme außerhalb von
		Gebäuden - Kanalmanagement.
	6	Zeitschrift 3R, Fachzeitschrift für sichere und effiziente
		Rohrleitungssysteme
	7	Handbuch für den Rohrleitungsbau Band 1 und 2, 4. Auflage,
		Günter Wossog, 2015
	8	Rohrleitungstechnik, Walter Wagner, Vogel Buchverlag, 2006
	9	Stein D., Stein R., "Instandhaltung von Kanalisationen", 1008 S.,
		ISBN 978-3-9810648-4-1   Verlag Prof. DrIng. Stein & Partner
		GmbH, 2014
	10	Stein, D., "Grabenloser Leitungsbau", 1. Auflage, Gebundene
		Ausgabe - 1166 Seiten, Ernst & Sohn Verlag, 2003, ISBN:
	11	3433017786
	11	Willoughby D:A: "Horizontal Directional Drilling: Utility and Pipeline Applications" Digital Engineering Library @ McGraw-Hill -
		The McGraw-Hill Companies, Inc., 2005
	12	Weidlich I., "Erddruck auf Rohre", 1. Auflage, ISBN 3-89999-027-

Course L2006: Simulation of	sewerage systems
Тур	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	<ul> <li>Modeling of sewer systems:</li> <li>Modeling approaches in wastewater management, especially approaches to integrated modeling</li> <li>Planning processes, calculations and design approaches for elements of gravity-sewers</li> <li>Model setup</li> <li>St. Venant equation and simplifications of models (kinematic wave etc.)</li> <li>Calculation &amp; modeling of solids transport (advection, diffusion, dispersion and sales processes)</li> <li>Examples for modeling with SWMM (EPA, USA)</li> </ul>
Literature	

Courses				
Title		Тур	Hrs/wk	СР
Wastewater Systems - Collection, 1	reatment and Reuse (L0934)	Lecture	2	2
Wastewater Systems - Collection, 1	reatment and Reuse (L0943)	Recitation Section (large)	1	1
Advanced Wastewater Treatment (		Lecture	2	2
Advanced Wastewater Treatment (	L0358) Recitation Section (large) 1 1			
	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous	Knowledge of wastewater management and	I the key processes involved in wastewater trea	tment.	
Knowledge				
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge		e full range of treatment systems in waste wate		
	dependence for sustainable water protection	n. They can describe relevant economic, enviro	nmental and social	factors.
Skills	Students are able to pre-design and explai	n the available wastewater treatment process	es and the scope o	of their application
Skills Students are able to pre-design and explain the available wastewater treatment processes and the scope of the municipal and for some industrial treatment plants.				
Personal Competence				
Social Competence	Social skills are not targeted in this module.			
Autonomy	Students are in a position to work on a su	ubject and to organize their work flow indepe	ndently. They can	also present on th
Autonomy	subject.	abject and to organize their work now indepe	nachtry. They can	diso present on ti
	545,555			
Workload in Hours	Independent Study Time 96, Study Time in I	Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural E			
Following Curricula	Civil Engineering: Specialisation Geotechnic			
	Civil Engineering: Specialisation Coastal Eng			
	Civil Engineering: Specialisation Water and			
		eneral Bioprocess Engineering: Elective Compu	-	
		ecialisation Environmental Engineering: Elective	Compulsory	
	Environmental Engineering: Specialisation V	vater: Elective Compulsory : Specialisation II. Process Engineering and Biote	choology: Elective	Compulson
		: Specialisation II. Energy and Environmental En	•••	
		mental Process Engineering: Elective Compulso		Compuisory
	Process Engineering: Specialisation Process		у	
	riocess Engineering. Specialisation Flocess	Engineering. Liective compulsory		
	Water and Environmental Engineering: Spec	rialisation Water: Compulsory		
	Water and Environmental Engineering: Spec	cialisation Water: Compulsory cialisation Environment: Elective Compulsory		

Course L0934: Wastewater S	systems - Collection, Treatment and Reuse
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
	<ul> <li>•Understanding the global situation with water and wastewater</li> <li>•Regional planning and decentralised systems</li> <li>•Overview on innovative approaches</li> <li>•In depth knowledge on advanced wastewater treatment options for different situations, for end-of-pipe and reuse</li> <li>•Mathematical Modelling of Nitrogen Removal</li> <li>•Exercises with calculations and design</li> </ul>
Literature	Henze, Mogens: Wastewater Treatment: Biological and Chemical Processes, Springer 2002, 430 pages George Tchobanoglous, Franklin L. Burton, H. David Stensel: Wastewater Engineering: Treatment and Reuse, Metcalf & Eddy McGraw-Hill, 2004 - 1819 pages

Course L0943: Wastewater Systems - Collection, Treatment and Reuse	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Ralf Otterpohl
Language	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	
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

Courses				
<b>Title</b> Noise Protection (L1109)	<b>Typ</b> Lecture		Hrs/wk 2	<b>CP</b> 2
Urban Infrastructures (L0874)		; -/problem-based Learning	2	4
	Dr. Dorothea Rechtenbach	prosient based Learning	-	•
Admission Requirements				
Recommended Previous				
Knowledge	<ul> <li>Knowledge on Urban planning</li> </ul>			
Kilowieuge	Knowledge on measures for climate protection			
	General knowledge of scientific writing/working			
Educational Objectives	After taking part successfully, students have reached the following learn	ing results		
Professional Competence				
•	Students can describe urban development corridors as well as current a	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 contri	bute to the im	provement of urb
	life. They can, for example, derive and discuss measures for effective no			
Skills Students are able to develop specific solutions for correcting existing or future environment-related development. They can define a range of conceptual and technical solutions for environmental problems for different solutions.				
	paths. To solve specific urban environmental problems they can select	technical innovations a	nd integrate t	hem into the urb
	context.			
Personal Competence				
Social Competence	The students can work together in international groups.			
Autonomy	Students are able to organize their work flow to prepare themselves fo	r presentations and cont	ributions to th	e discussions. Th
	can acquire appropriate knowledge by making enquiries independently.			
Credit points	Independent Study Time 124, Study Time in Lecture 56			
Course achievement				
Examination				
Examination duration and				
Examination duration and scale				
-	Civil Engineering: Specialisation Structural Engineering: Elective Comput	-		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Com Civil Engineering: Specialisation Coastal Engineering: Elective Compulso			
		' y		
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory			
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory			
	Environmental Engineering: Core qualification: Elective Compulsory	v: Core qualification: Con	nnulson	
	Environmental Engineering: Core qualification: Elective Compulsory Joint European Master in Environmental Studies - Cities and Sustainabilit			
	Environmental Engineering: Core qualification: Elective Compulsory	lobility: Elective Compuls		

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
Applied Surface Hydrology (L0289)		Lecture	2	2
Applied Surface Hydrology (L1412)		Project-/problem-based Lear	5	2
nteraction Water - Environment in		Project-/problem-based Lear	ning 1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
<b>Recommended Previous</b>	Fundamentals of Hydromechanics and Hyd	raulic Engineering: Hydraulic Engineering I and H	ydraulic Engineeri	ing II
Knowledge				
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	The students are able to define the basic	concepts of hydrology and water management.	They are able to o	describe and quan
	the relevant processes of the hydrological	water cycle. Besides, the students know the mai	n aspects of rainfa	all-run-off-models a
	are able to theoretically derive established	reservoir / storage models and a unit-hydrograp	n.	
Skille	The students are able to use the basis h	udralagical concents and approaches and are	bla ta theoretical	lly dorivo octablic
SKIIIS	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			
	concepts of measurements of hydrological and hydrodynamic values in nature and are able to perform, analyze and statistical			
		they are able to apply a hydrological model to be		-
	ussess these measurements. Furthermore,		sie nyarological p	robierns.
Personal Competence				
Social Competence	The students are able to deploy their gaine	ed knowledge in applied problems of the hydrolog	Jy and water mana	agement. Addition
	they will be able to work in team with engi	neers of other disciplines.		
Autonomy	The students will be able to independently	extend their knowledge and apply it to new prob	lems	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 90 min. The examination includes tasks with respect to the general understanding of the lectu			
scale	contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Water and	Traffic: Elective Compulsory		
Following Curricula	Environmental Engineering: Core qualificat	ion: Elective Compulsory		
	Joint European Master in Environmental St	udies - Cities and Sustainability: Core qualification	1: Compulsory	
	Water and Environmental Engineering: Spe	cialisation Water: Elective Compulsory		
	Water and Environmental Engineering: Spe	cialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Spe	cialisation Cities: Elective Compulsory		

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:	
	<ul> <li>Hydrological cycle</li> <li>Data acquisition</li> <li>Data analyses and statistical assessment</li> <li>Statistics of extremes</li> <li>Regionalization methods for hydrological values</li> <li>Rainfall-run-off modelling on the basis of a unit hydrograph conceps</li> <li>Application of rainfall-run-off models on the basis of Kalypso-Hydrology which is an OpenSource Software Tool.</li> </ul>	
Literature	http://kalypso.bjoernsen.de/ http://sourceforge.net/projects/kalypso/	

Course L1412: Applied Surfa	urse 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		

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
Ecological Town Design - Water, Er	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 Knowledge	Basic knowledge of the global situation with rising poverty, soil degradation, migration to cities, lack of water resources ar sanitation			
Educational Objectives	After taking part successfully, students have r	eached the following learning results		
Professional Competence				
Knowledge	Students can describe the facets of the global water situation. Students can judge the enormous potential of the implementation synergistic systems in Water, Soil, Food and Energy supply.			
Skills	Students are able to design ecological settlements for different geographic and socio-economic conditions for the main climal around the world.			
Personal Competence				
Social Competence	The students are able to develop a specific top	pic in a team and to work out milestones	s according to a given pla	an.
Autonomy	Students are in a position to work on a sub subject.	ject and to organize their work flow ir	dependently. They can	also present on th
Workload in Hours	Independent Study Time 124, Study Time in L	ecture 56		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	During the course of the semester, the stude	nts work towards mile stones. The work	includes presentations	and papers. Detail
scale	information can be found at the beginning of t	he smester in the StudIP course module	handbook.	
Assignment for the	Civil Engineering: Specialisation Water and Tra	affic: Elective Compulsory		
Following Curricula	Bioprocess Engineering: Specialisation A - Ger	eral Bioprocess Engineering: Elective C	ompulsory	
	Chemical and Bioprocess Engineering: Special	isation General Process Engineering: Ele	ective Compulsory	
	Environmental Engineering: Core qualification	Elective Compulsory		
	Joint European Master in Environmental Studie	es - Cities and Sustainability: Core qualif	ication: Compulsory	
	Process Engineering: Specialisation Environme	ental Process Engineering: Elective Com	pulsory	
	Process Engineering: Specialisation Process Er	ngineering: Elective Compulsory		
	Water and Environmental Engineering: Specia	lisation Water: Elective Compulsory		
	Water and Environmental Engineering: Specia	lisation Environment: Elective Compulso	ory	
	Water and Environmental Engineering: Specia	lisation Cities: Elective Compulsory		

Course L1229: Ecological Tov	vn 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	<ul> <li>Participants Workshop: Design of the most attractive productive Town</li> <li>Keynote lecture and video</li> <li>The limits of Urbanization / Green Cities</li> <li>The tragedy of the Rural: Soil degradation, agro chemical toxification, migration to cities</li> <li>Global Ecovillage Network: Upsides and Downsides around the World</li> <li>Visit of an Ecovillage</li> <li>Participants Workshop: Resources for thriving rural areas, Short presentations by participants, video competion</li> <li>TUHH Rural Development Toolbox</li> <li>Integrated New Town Development</li> <li>Participants workshop: Design of New Towns: Northern, Arid and Tropical cases</li> <li>Outreach: Participants campaign</li> <li>City with the Rural: Resilience, quality of live and productive biodiversity</li> </ul>
Literature	<ul> <li>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</li> <li>http://youtu.be/9hmkgn0nBgk (Miracle Water Village, India, Integrated Rainwater Harvesting, Water Efficiency, Reforestation and Sanitation)</li> <li>TEDx New Town Ralf Otterpohl: http://youtu.be/_M0J2u9BrbU</li> </ul>

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

Courses				
Title		Тур	Hrs/wk	СР
Digital Building (L1908)		Lecture	2	2
Lean Construction (L1910)		Lecture	2	2
System Dynamics (L1909)		Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>				
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 96, Study Time	e in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coasta	l Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotec	hnical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Structu	Iral Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water	and Traffic: Elective Compulsory		

Course L1908: Digital Buildir	Course L1908: Digital Building		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Dr. Katja Maaser		
Language	DE		
Cycle	SoSe		
Content			
Literature			

Course L1910: Lean Construction		
Тур	Lecture	
Hrs/wk		
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Theo Herzog	
Language	DE	
Cycle	SoSe	
Content		
Literature		

Course L1909: System Dynar	ourse L1909: System Dynamics		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Dr. Markus Salge		
Language	DE		
Cycle	SoSe		
Content			
Literature			

Courses				
<b>Fitle</b>		Тур	Hrs/wk	СР
Modeling Processes in Vadose Zone		Lecture	1	1
Modeling Processes in Vadose Zone /adose Zone Hydrology (L2732)	(L2735)	Recitation Section (small) Lecture	1 2	1 2
/adose Zone Hydrology (L2732)		Recitation Section (large)	2	2
Module Responsible	Prof. Nima Shokri		_	_
Admission Requirements				
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in I	Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Water and	Traffic: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Water and	Traffic: Elective Compulsory		
	Environmental Engineering: Specialisation V	Vater: Elective Compulsory		
	Environmental Engineering: Specialisation V	Vater: Elective Compulsory		
	Water and Environmental Engineering: Spec			
	• • •	cialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Spec			
	Water and Environmental Engineering: Spec			
	Water and Environmental Engineering: Spec	ialisation Environment: Elective Compulsory		

Course L2734: Modeling Processes in Vadose Zone		
Тур	Lecture	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Nima Shokri	
Language	EN	
Cycle	SoSe	
Content		
Literature		

Course L2735: Modeling Processes in Vadose Zone		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Hannes Nevermann	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L2732: Vadose Zone	urse 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			
Literature			

Course L2733: Vadose Zone	urse 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
Advanced Modeling Techniques for Multiphase Flow in Porous Media (L2738)		Recitation Section (small)	2	2
Fundamentals of Multiphase Flow in Porous Media (L2736) Fundamentals of Multiphase Flow in Porous Media (L2737)		Lecture Recitation Section (large)	2	2
•	Module Responsible Prof. Nima Shokri			Z
Admission Requirements				
Recommended Previous				
Knowledge				
5	After taking part successfully, students have reach	ned the following learning results		
Professional Competence	when taking part successivily, stadents have reach			
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	ndependent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	lone			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engi	neering: Elective Compulsory		
	Civil Engineering: Specialisation Geotechnical Engi	neering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory		
	Environmental Engineering: Specialisation Water:	Elective Compulsory		
	Environmental Engineering: Specialisation Water:			
	Water and Environmental Engineering: Specialisat			
	Water and Environmental Engineering: Specialisat			
	Water and Environmental Engineering: Specialisat			
	Water and Environmental Engineering: Specialisat			
	Water and Environmental Engineering: Specialisat Water and Environmental Engineering: Specialisat	ion water: Elective Compulsory		

Course L2738: Advanced Mo	deling Techniques for Multiphase Flow in Porous Media
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Alexandru Tatomir
Language	EN
Cycle	SoSe
Content	
Literature	

Course L2736: Fundamentals	s of Multiphase Flow in Porous Media
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Alexandru Tatomir
Language	EN
Cycle	SoSe
Content	
Literature	

Course L2737: Fundamentals	se L2737: Fundamentals of Multiphase Flow in Porous Media		
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Hannes Nevermann		
Language	EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Typ Project-/problem-based Learning Lecture ng learning results	Hrs/wk 3 1	<b>CP</b> 4 2	
Project-/problem-based Learning Lecture	3	4	
Lecture			
		2	
ng learning results			
Report (about 5-10 pages) and Presentation (about 15 min)			
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Course L2754: Water and Environment: Application and Field Work	
Тур	Project-/problem-based Learning
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Dr. Alexandru Tatomir, Hannes Nevermann
Language	EN
Cycle	SoSe
Content	
Literature	

ourse L2753: Water and Environment: Theory		
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	SoSe	
Content		
Literature		

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 "Trans 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.
	<ul> <li>describe the main determinants of urban development.</li> </ul>
	<ul> <li>explain and compare different possibilities of how urban development can be influenced.</li> </ul>
	<ul> <li>discuss requirements for public streetscapes.</li> </ul>
	explain the importance of street design.
Skills	Students are able to:
	<ul> <li>read and analyze urban development concepts and designs for streetscapes</li> </ul>
	appraise such concepts in the context of competing requirements.
	<ul> <li>design, justify and reflect their own solutions for concrete examples.</li> </ul>
Personal Competence	
Social Competence	Students are able to:
	discuss intermediate results with each other.
	constructively accept feedback on their own work.
	<ul> <li>provide constructive feedback to others.</li> </ul>
Autonomy	Students are able to:
	<ul> <li>independently complete a written report including drawings following a broadly pre-defined process.</li> <li>assess the consequences of their proposed solutions.</li> </ul>
	<ul> <li>independently acquire knowledge and apply this to new issues or problem areas.</li> </ul>
Workload in Hours Credit points	Independent Study Time 124, Study Time in Lecture 56
-	
Course achievement Examination	None Written elaboration
	written assignment, designwork during the semester
scale	whiten assignment, designwork during the semester
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory
<b>3</b> • • • • •	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 Water: 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:
	<ul> <li>legal framework,</li> <li>instruments and methods of planning,</li> <li>functional requirements,</li> <li>stakeholders and actors</li> <li>basic design requirements</li> <li>different planning levels and</li> <li>historical contexts.</li> </ul> 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 (2009) Stadtplanung: Eine illustrierte Einführung. Primus Verlag. Darmstadt.
	Frick, Dieter (2008) Theorie des Städtebaus: Zur baulich-räumlichen Organisation von Stadt. 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.

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Courses					
Title	Тур		Hrs/wk	СР	
Construction Logistics (L1163)	Lect		1	2	
Construction Logistics (L1164)		tation Section (small)	1	2	
Project Development and Management (L1161)     Lecture       Project Development and Management (L1162)     Project-/problem-based Learning		1	1		
Module Responsible		cet /problem bused Learning	1	1	
Admission Requirements	-				
Recommended Previous	none				
Knowledge	hone				
Educational Objectives	After taking part successfully, students have reached the following lea	arning results			
Professional Competence	The taking part baccessiany, stadents have redened the following lea				
-	Students can				
, and the age					
	• give definitions of the main terms of construction logistics and	project development and m	anagement		
	<ul> <li>name advantages and disadvantages of internal or external co</li> </ul>	nstruction logistics			
	<ul> <li>explain characteristics of products, demand and production of</li> </ul>	construction objects and the	eir consequer	nces for constructio	
	specific supply chains				
	differentiate constructions logistics from other logistics systems				
Skills	Students can				
	carry out project life cycle assessments				
	<ul> <li>apply methods and instruments of construction logistics</li> <li>apply methods and instruments of project development and management</li> <li>apply methods and instruments of conflict management</li> </ul>				
	<ul> <li>apply methods and instruments of conflict management</li> </ul>				
	<ul> <li>design supply and waste removal concepts for a construction p</li> </ul>	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				
	<ul> <li>improve their creativity, negotiation skills, conflict and crises studies</li> </ul>	solution skills by applying	methous 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 Com	pulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Co	ompulsory			
	Civil Engineering: Specialisation Coastal Engineering: Elective Comput	lsory			
	Civil Engineering: Specialisation Water and Traffic: Elective Compulso	ry			
	International Management and Engineering: Specialisation II. Civil Eng		ory		
	International Management and Engineering: Specialisation II. Logistics	s: Elective Compulsory			
	Logistics, Infrastructure and Mobility: Specialisation Production and Lo	ogistics: Elective Compulsory	/		

Tur	Logistics Lecture		
Hrs/wk			
CP			
	ndependent Study Time 46, Study Time in Lecture 14 Prof. Heike Flämig		
Language			
Cycle Content	SoSe         The lecture gives deeper insight how important logistics are as a competetive factor for construction projects and which issues ar 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 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, Pete 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		

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:				
	<ul> <li>Terms and definitions of project management</li> <li>Advantages and disadvantages of different ways of project handling</li> <li>organization, information, coordination and documentation</li> <li>cost and fincance management in projects</li> <li>time- and capacity management in projects</li> <li>specific methods and instruments for successful team work</li> </ul> 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 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	ıre	2	2
Technology of mineral Building Mat	erials (L0256)		Proje	ct-/problem-based Learning	1	2
Transport Processes in Building Ma	Naterials and Damage Processes (L0254) Lecture 1 1				1	
Module Responsible	Prof. Frank Schmidt-Döhl					
Admission Requirements	None					
<b>Recommended Previous</b>	Basic knowledge about building materials, building physics and building chemistry, for example by the modules Principles o					
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 dis	-	nd and adjust their	results. The students are	able to manu	ifacture their spec
	building material on the basis o	f this feedback.				
Autonomy	The students are able to respo	nsibly use the reso	ources of materials a	and lab equipment for their	r project and	to investigate and
	get missing components.					
Workload in Hours	Independent Study Time 110, S	itudy Time in Lectu	ire 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	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			
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				
		-	11	
Title		<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 2
Structural Dynamics (L1202) Structural Dynamics (L1203)		Recitation Section (large)	2	2
	steel structures (L0564)	Lecture	1	1
Fracture mechanics and fatigue in steel structures (L0564)       Lecture         Fracture mechanics and fatigue in steel structures (L0565)       Recitation Section (large)			1	1
Module Responsible	Prof. Uwe Starossek			
Admission Requirements				
	Knowledge of linear structural analysis of sta	tically determinate and indeterminate structu	res: Mechanics	I/II. Mathematics
	Differential equations I			,,
Educational Objectives	After taking part successfully, students have re	ached the following learning results		
Professional Competence				
-	After successful completion of this module, th respective methods.			
Skills	After successful completion of this module,	the students will be able to predict the resp	ponse of materi	al and structures
	dynamics loading using the appropriate compu	tational approaches and methods.		
Personal Competence		tational approaches and methods.		
<b>Personal Competence</b> Social Competence		tational approaches and methods.		
	Students can	isciplinary discussions,		
	Students can <ul> <li>participate in subject-specific and interd</li> </ul>	isciplinary discussions, others		
	Students can <ul> <li>participate in subject-specific and interd</li> <li>defend their own work results in front of</li> </ul>	isciplinary discussions, others Dlleagues		
Social Competence	Students can <ul> <li>participate in subject-specific and interd</li> <li>defend their own work results in front of</li> <li>promote the scientific development of contract of the scientific development of</li></ul>	isciplinary discussions, others olleagues orofessional constructive criticism oject area from given and other sources and ap	oply it to new pro	
Social Competence Autonomy	Students can   participate in subject-specific and interd  defend their own work results in front of  promote the scientific development of co  Furthermore, they can give and accept p  Students are able to gain knowledge of the sub-	isciplinary discussions, others olleagues professional constructive criticism oject area from given and other sources and ap for problems in the area of Structural Analysis.	oply it to new pro	
Social Competence Autonomy	Students can    participate in subject-specific and interd  defend their own work results in front of  promote the scientific development of cc  Furthermore, they can give and accept p  Students are able to gain knowledge of the sut they are able to structure the solution process  Independent Study Time 96, Study Time in Lec	isciplinary discussions, others olleagues professional constructive criticism oject area from given and other sources and ap for problems in the area of Structural Analysis.	oply it to new pro	
Social Competence Autonomy Workload in Hours	Students can   participate in subject-specific and interd  defend their own work results in front of  promote the scientific development of cc  Furthermore, they can give and accept p  Students are able to gain knowledge of the sut they are able to structure the solution process Independent Study Time 96, Study Time in Lec 6	isciplinary discussions, others olleagues professional constructive criticism oject area from given and other sources and ap for problems in the area of Structural Analysis.	oply it to new pro	
Social Competence Autonomy Workload in Hours Credit points Course achievement	Students can   participate in subject-specific and interd  defend their own work results in front of  promote the scientific development of cc  Furthermore, they can give and accept p  Students are able to gain knowledge of the sut they are able to structure the solution process Independent Study Time 96, Study Time in Lec 6	isciplinary discussions, others olleagues professional constructive criticism oject area from given and other sources and ap for problems in the area of Structural Analysis.	oply it to new pro	
Social Competence Autonomy Workload in Hours Credit points Course achievement	Students can   participate in subject-specific and interd  defend their own work results in front of  promote the scientific development of co Furthermore, they can give and accept p Students are able to gain knowledge of the sub they are able to structure the solution process Independent Study Time 96, Study Time in Lec Knone Written exam	isciplinary discussions, others olleagues professional constructive criticism oject area from given and other sources and ap for problems in the area of Structural Analysis.	oply it to new pro	
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and	Students can   participate in subject-specific and interd  defend their own work results in front of  promote the scientific development of co Furthermore, they can give and accept p Students are able to gain knowledge of the sub they are able to structure the solution process Independent Study Time 96, Study Time in Lec 6 None Written exam 150 min	isciplinary discussions, others olleagues professional constructive criticism oject area from given and other sources and ap for problems in the area of Structural Analysis.	oply it to new pro	
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale	Students can   participate in subject-specific and interd  defend their own work results in front of  promote the scientific development of co Furthermore, they can give and accept p Students are able to gain knowledge of the sut they are able to structure the solution process Independent Study Time 96, Study Time in Lec Knone Written exam 150 min	isciplinary discussions, others olleagues orofessional constructive criticism oject area from given and other sources and ap for problems in the area of Structural Analysis. ture 84	oply it to new pro	
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students can    participate in subject-specific and interd  defend their own work results in front of  promote the scientific development of co Furthermore, they can give and accept p Students are able to gain knowledge of the sut they are able to structure the solution process Independent Study Time 96, Study Time in Lec  None Written exam 150 min Civil Engineering: Specialisation Structural Engi	isciplinary discussions, others olleagues orofessional constructive criticism oject area from given and other sources and ap for problems in the area of Structural Analysis. ture 84	oply it to new pro	
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale	Students can   participate in subject-specific and interd  defend their own work results in front of  promote the scientific development of co Furthermore, they can give and accept p Students are able to gain knowledge of the sut they are able to structure the solution process Independent Study Time 96, Study Time in Lec Knone Written exam I50 min Civil Engineering: Specialisation Structural Engi Civil Engineering: Specialisation Geotechnical E	isciplinary discussions, others olleagues orofessional constructive criticism oject area from given and other sources and ap for problems in the area of Structural Analysis. ture 84	oply it to new pro	
Social Competence Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	Students can    participate in subject-specific and interd  defend their own work results in front of  promote the scientific development of co Furthermore, they can give and accept p Students are able to gain knowledge of the sut they are able to structure the solution process Independent Study Time 96, Study Time in Lec  None Written exam 150 min Civil Engineering: Specialisation Structural Engi	isciplinary discussions, others olleagues orofessional constructive criticism oject area from given and other sources and ap for problems in the area of Structural Analysis. ture 84 ineering: Compulsory ingineering: Elective Compulsory ering: Elective Compulsory	oply it to new pro	

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. Uwe Starossek		
Language	DE		
Cycle	SoSe		
Content	<ul> <li>Single-degree-of-freedom systems: undamped and damped vibration, free vibration, forced vibrations due to harmonic, periodical or arbitrary loading, natural frequency, damping</li> <li>vibration isolation</li> <li>solution in the frequency-domain (Fourier transformation), solution in the time-domain</li> <li>multi-degree-of-freedom systems: continuous or discrete systems, modelling with finite elements, generalisation</li> <li>modal analysis</li> <li>power iteration according to v.Mises</li> <li>earthquake loading: seismological basics, response spectrum method</li> <li>wind-induced vibrations: engineering meteorology, aerodynamic, classification of excitation mechanisms</li> </ul>		
Literature	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		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Uwe Starossek		
Language	DE		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Тур	Lecture
Hrs/wk	
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Jürgen Priebe
Language	DE
Cycle	SoSe
Content	<ul> <li>basics of fatigue stress and fatigue resistance and determination of fatigue strength,</li> </ul>
	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,
	<ul> <li>set up of determination of fatigue strength in different examples,</li> </ul>
	<ul> <li>basics of construction and design regarding the problem of material fatigue,</li> </ul>
	<ul> <li>basics of linear elastic fracture mechanics under static and dynamic load,</li> </ul>
	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 1996
	Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993
	<ul> <li>DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsreg</li> <li>Bemessungsregeln f         ür den Hochbau; 1993</li> </ul>
	• 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 200

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
Fransportation Modelling (L1180)	Project-/problem-based Lea	arning 4	6
Module Responsible	Prof. Carsten Gertz		
Admission Requirements	None		
<b>Recommended Previous</b>	some knowledge of transport planning, e.g. through taking the undergraduate class "Tran	sport Planning and	d Traffic Engineerin
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 mod	lels.	
Chille	Students are able to:		
SKIIIS	Students are able to:		
	<ul> <li>use travel demand modelling software packages for solving practical problems.</li> </ul>		
	<ul> <li>design a database structure for travel demand models.</li> </ul>		
	<ul> <li>assess modelling results.</li> </ul>		
	<ul> <li>appraise potential applications and limitations of such models.</li> </ul>		
	<ul> <li>Students are able to independently develop and document solutions.</li> <li>Students are able to: <ul> <li>independently organise, manage and solve set tasks.</li> <li>independently prepare written reports.</li> </ul> </li> </ul>		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Credit points			
•			
	Written elaboration		
Examination duration and	written assignment with presentation during the semester		
scale			
Assignment for the	Civil Engineering: Specialisation Water and Traffic: Compulsory		
Following Curricula		ompulsory	
-	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory		

Course L1180: Transportation Modelling		
Тур	Project-/problem-based Learning	
Hrs/wk		
СР	6	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Prof. Carsten Gertz	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Principles of transport modelling</li> <li>Role of transport modelling in the planning process</li> <li>Fundamentals of mobility behaviour</li> <li>Design and evaluation of transport/mobility surveys</li> <li>mode of operation and data requirements for different stages of modelling</li> <li>Forecasting and scenarios in the transport planning</li> <li>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)</li> <li>Practice-oriented project for assessing consequences of infrastructure projects and changes in land-use</li> </ul>	
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.	

Courses				
Title		Тур	Hrs/wk	СР
Solid Matter Process Technology fo	r Biomass (L0052)	Lecture	2	2
Thermal Waste Treatment (L0320)		Lecture	2	2
Thermal Waste Treatment (L1177)		Recitation Section (large)	) 1	2
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements	None			
<b>Recommended Previous</b>	Basics of			
Knowledge	therme dynamics			
	thermo dynamics			
	<ul><li>fluid dynamics</li><li>chemistry</li></ul>			
	• chemistry			
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge	The students can name, describe curre	ent issue and problems in the field of therm	al waste treatment	and particle proce
	engineering and contemplate them in the	e context of their field.		
	The industrial application of unit operation	ons as part of process engineering is explained	l by actual examples	of waste incineratio
		es. Compostion, particle sizes, transportation		
	•	cribed as important unit operations when produ		
	and refining edible oils, electricity , heat			
Skills		processes for the treatment of wastes or raw m		
	and the process aims. They can evaluate	the efforts and costs for processes and select e	conomically feasible	treatment concepts
Personal Competence				
Social Competence	Students can			
	<ul> <li>respectfully work together as a tea</li> </ul>			
	participate in subject-specific and	Interdisciplinary discussions,		
	<ul> <li>develop cooperated solutions</li> <li>promote the scientific development</li> </ul>	nt and accept professional constructive criticisn	-	
	• promote the scientific development		1.	
Autonomy	Students can independently tap knowl	edge of the subject area and transform it	to new questions. T	hey are capable,
	consultation with supervisors, to assess	their learning level and define further steps of	n this basis. Furtherm	nore, they can defir
	targets for new application-or research-o	riented duties in accordance with the potential	social, economic and	cultural impact.
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points				
Course achievement				
Examination duration and	Written exam			
scale				
	Civil Engineering: Specialisation Water ar	nd Traffic: Elective Compulsory		
5	5 5 1	- General Bioprocess Engineering: Elective Com	pulsory	
		Specialisation Energy and Environmental Engine		ulsory
		ng: Specialisation II. Process Engineering and Bi	•	-
	• •	ng: Specialisation II. Renewable Energy: Elective		
	Renewable Energies: Specialisation Bioer			
	Process Engineering: Specialisation Chem	nical Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Proce	ss Engineering: Elective Compulsory		
	Process Engineering: Specialisation Envir	onmental Process Engineering: Elective Compu	sory	
	Water and Environmental Engineering: S	pecialisation Environment: Compulsory		
	Water and Environmental Engineering: S	pecialisation Cities: Elective Compulsory		

Course L0052: Solid Matter F	Process Technology for Biomass
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
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 L0320: Thermal Wast	re 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	SoSe
Content	<ul> <li>Introduction, actual state-of-the-art of waste incineration, aims. legal background, reaction principals</li> <li>basics of incineration processes: waste composition, calorific value, calculation of air demand and flue gas composition</li> <li>Incineration techniques: grate firing, ash transfer, boiler</li> <li>Flue gas cleaning: Volume, composition, legal frame work and emission limits, dry treatment, scrubber, de-nox techniques, dioxin elimination, Mercury elimination</li> <li>Ash treatment: Mass, quality, treatment concepts, recycling, disposal</li> </ul>
Literature	Thomé-Kozmiensky, K. J. (Hrsg.): Thermische Abfallbehandlung Bande 1-7. EF-Verlag für Energie- und Umwelttechnik, Berlin, 196 - 2013.

Course L1177: Thermal Waste Treatment	
Тур	Recitation Section (large)
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Kerstin Kuchta
Language	EN
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 Modflow (L0543)		Lecture	1	1
Groundwater Modeling using Modfl		Recitation Section (small)	2	2
Modeling of Water Supply and Sew	er Network (L0875)	Project-/problem-based Learning	2	3
Module Responsible	Dr. Klaus Johannsen			
Admission Requirements	None			
Recommended Previous	Groundwater			
Knowledge	<ul> <li>groundwater hydraulics and transport of sub</li> </ul>	ostances		
	Pipe Systems			
	<ul> <li>Knowledge on urban water infrastructures, in particular drinking water systemsand urban drainage systems inclu special structures</li> <li>Hydraulics of drinking water supply systems and sewer systems</li> <li>Basic knowledge on water management</li> </ul>			
Educational Objectives	After taking part successfully, students have reach	ed 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. 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				
	Wird nicht vermittelt.			
	Wird nicht vermittelt.			
Workload in Hours	Independent Study Time 110, Study Time in Lectur	re 70		
Credit points				
Course achievement				
Examination				
Examination duration and				
scale				
Assignment for the	Civil Engineering: Specialisation Structural Enginee	ring: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engi	• • •		
	Civil Engineering: Specialisation Coastal Engineering	ng: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory		
	Water and Environmental Engineering: Specialisati	on Water: Compulsory		
	Water and Environmental Engineering: Specialisati	on Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisati	on Cities: 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	ourse 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 and Sewer 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, Weitere Mitarbeiter	
Language	DE	
Cycle	SoSe	
Content		
Literature	Mutschmann/Stimmelmayr: Taschenbuch der Wasserversorgung, 16. Auflage. Springer Vieweg - Verlag. Wiesbaden 2014.	

Module M0870: Mana	gement of Surface Water			
Courses				
Title		Тур	Hrs/wk	СР
Modelling of Flow in Rivers and Est		Lecture	3	4
	ring / Integrated Flood Protection (L0961)	Project-/problem-based Lea	rning 2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
<b>Recommended Previous</b>	Fundamentals of Hydromechanics, Hydraulics, Hydrology and Hydraulic Engineering; Hydraulic Engineering I and Hydraul			
Knowledge	Engineering II			
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 in hydraulic engineerin Besides, they can describe the basic aspects of numerical modelling and actual numerical models for the simulation of flows a			
	waves. They can also depict the concepts of nature	e oriented hydraulic engineering.		
Skills	Students are able to apply hydrodynamic-numerica	al models to practical hydraulic engineer	ing tasks. Furtherm	nore, the students a
	able to set up flood-risk management concepts and	d are able to apply basic concepts of ren	aturation to practic	al problems.
Personal Competence				
Social Competence	The students are able to deploy their gained know	wledge in applied problems of the practi	ical nature-based h	ydraulic engineerin
	Additionaly, 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 prol	blems.	
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	The duration of the examination is 150 min. The	e examination includes tasks with respe	ect to the general	understanding of t
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Water and Traffic:	Compulsory		
Following Curricula	Environmental Engineering: Core qualification: Elec	ctive Compulsory		
	Joint European Master in Environmental Studies - C	Cities and Sustainability: Core qualification	on: Compulsory	
	Water and Environmental Engineering: Specialisati	ion Water: Compulsory		
	Water and Environmental Engineering: Specialisati	ion Environment: Compulsory		
	Water and Environmental Engineering: Specialisati	ion Cities: Elective Compulsory		

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	
Language	
Cycle	
Content	
	<ul> <li>Processes affecting tht flow</li> <li>Examples and applications of numerical models</li> <li>Procedure of numerical modelling</li> </ul>
	Model concept Basic equations of hydrodynamics
	<ul> <li>Saint-Venant equations</li> <li>Euler Equations</li> <li>Navier-Stokes equations</li> <li>Reynolds-averaged Navier-Stokes equations</li> </ul>
	Shallow water equations Solving schemes
	<ul> <li>Numerical discretization</li> <li>Solution algorithms</li> <li>Convergence</li> </ul>
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. 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).

Course L0961: Nature-Orient	rse L0961: Nature-Oriented 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	<ul> <li>Regime-Theory and application for the development of environmental guiding priciples of rivers</li> <li>Engineering - biological measures for the stabilization of rivers</li> <li>Risk management in flood protection</li> <li>Design techniques in technical flood protection</li> <li>Methods for the assessment of flood caused damages</li> </ul>	
Literature	Vorlesungsumdruck	

Courses				
Title		Тур	Hrs/wk	СР
Harbour Engineering (L0809)		Lecture	2	2
Harbour Engineering (L1414) Port Planning and Port Constructio	(10378)	Project-/problem-based Learning Lecture	1 2	2
Module Responsible		Lecture	2	2
Admission Requirements				
	Basics of coastal engineering			
Knowledge				
	After taking part successfully, students have reached the followir	ng learning results		
Professional Competence		5 5		
•	The students are able to define in details and to choose design	approaches for the functional d	lesign of a po	rt and apply them
5	design tasks. They can design the fundamental elements of a por		5 1	11.5
Skills	The students are able to select and apply appropriate approaches	s for the functional design of por	rts.	
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 disciplin	ies.		
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 examination	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: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Electi	ve Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Compulsory	Ý		
	Civil Engineering: Specialisation Water and Traffic: Elective Comp	oulsory		
	International Management and Engineering: Specialisation II. Civi	I Engineering: Elective Compuls	ory	
	Theoretical Mechanical Engineering: Technical Complementary C	ourse: Elective Compulsory		

Course L0809: Harbour Engineering		
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	<ul> <li>Fundamentals of harbor engineering <ul> <li>Maritime transportation and waterways engineering</li> <li>Ships</li> </ul> </li> <li>Elements of harbors <ul> <li>Harbor approaches and water-side harbor areas</li> <li>Terminal design and handling of cargo</li> <li>Quay-walls and piers</li> <li>Equipment of harbors</li> <li>Sluices and other special constructions</li> </ul> </li> <li>Connection to inland transportation / inland waterway transportation</li> <li>Protection of harbors <ul> <li>Breakwaters and Jetties</li> <li>Wave protection of harbors</li> </ul> </li> <li>Fishery and other small harbors</li> </ul>	
Literature	Brinkmann, B.: Seehäfen, Springer 2005	

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	

Lecturer Frank Feind Language DE Cycle SoSe Content • Plann • Mark • Plann • Port p • Deve • Quay • Speci	nt Study Time 32, Study Time in Lecture 28 dt ining and implementation of major projects
CP       2         Workload in Hours       Independen         Lecturer       Frank Feind         Language       DE         Cycle       SoSe         Content       • Plann         • Port p       • Deve         • Quay       • Speci	dt
Lecturer Frank Feind Language DE Cycle SoSe Content • Plann • Mark • Plann • Port p • Deve • Quay • Speci	dt
Lecturer Frank Feind Language DE Cycle SoSe Content • Plann • Mark • Plann • Port p • Deve • Quay • Speci	dt
Cycle SoSe Content Plann Mark Plann Port p Deve Quay Speci	ining and implementation of major projects
Content Plann Mark Plann Port p Deve Quay Speci	ning and implementation of major projects
<ul> <li>Plann</li> <li>Mark</li> <li>Plann</li> <li>Port p</li> <li>Deve</li> <li>Quay</li> <li>Special</li> </ul>	ining and implementation of major projects
<ul><li>Flood</li><li>Port c</li><li>Prepa</li></ul>	ket analysis and traffic relations ining process and plan planning in urban neighborhood elopment of the logistics center "Port of Hamburg" in the metropolis ys and waterfront structure cial planning Law Harbor - securing of a flexible use of the port ensioning of quays d protection structures of Hamburg - Infrastructure and development paration of areas ur formation in front of shore structures

Module M0857: Geocl	nemical Engineering				
Courses					
Title		Тур	Hrs/wk	СР	
Contaminated Sites and Landfilling	(L0906)	Lecture	2	2	
Contaminated Sites and Landfilling (L0907) Recitation Section (large)			1	2	
Geochemical Engineering (L0904)		Lecture	2	2	
Module Responsible	Dr. Marco Ritzkowski				
Admission Requirements	None				
<b>Recommended Previous</b>	Module: General and Inorganic Chemistry,				
Knowledge	Module:Organic Chemistry,				
	Biology (Basic Knowledge)				
Educational Objectives	After taking part successfully, students have	e reached the following learning results			
Professional Competence					
Knowledge	With the completion of this module students acquire profound knowledge of biogeochemical processes, the fate of pollutants				
	soil and groundwater, and techniques to deposit contaminated waste material. They are able to describe in principle the behaviou				
	of chemicals in the environment. Students can explain and report the approach to remediate contaminated sites.				
Skills	With the completion of this module students can apply the acquired theoretical knowledge to model cases of site pollution ar				
	critically assess the situation technically and conceptually. They are able to draw comparisons on different remediation strategie				
	and techniques. Model projects can be devised and treated.				
Personal Competence					
Social Competence	Students can discuss technical and scientifi	c tasks within a seminar subject specific and in	terdisciplinary .		
Autonomy	Students can independently exploit sources	, acquire the particular knowledge of the subject	ct and apply it to n	ew 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	2 hours				
scale					
Assignment for the	Civil Engineering: Specialisation Water and T	Fraffic: Elective Compulsory			
Following Curricula	Environmental Engineering: Core qualification	on: Elective Compulsory			
	Water and Environmental Engineering: Spec	ialisation Water: Elective Compulsory			
	Water and Environmental Engineering: Spec	ialisation Environment: Elective Compulsory			
	Water and Environmental Engineering: Spec	ialisation Cities: Elective Compulsory			

Course L0906: Contaminated	l Sites and Landfilling
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Marco Ritzkowski, Dr. Joachim Gerth
Language	EN
Cycle	SoSe
Content	The part Contaminated Sites gives an introduction into different scales of pollution and identifies key pollutants. Geochemical attenuation mechanisms and the role of organisms are highlighted affecting the fate of pollutants in leachate and groundwater. Techniques for site characterization and remediation are discussed including economical aspects. The part Landfilling is introduced by discussing fundamental aspects and the worldwide situation of waste management. The lecture highlights transformation processes in landfill bodies, emissions of gases and leachate, and the long-term behaviour of landfill sites with measures of aftercare.
Literature	<ol> <li>Waste Management. Bernd Bilitewski; Georg Härdtle; Klaus Marek (Eds.), ISBN: 9783540592105, Springer Verlag Lehrbuchsammlung der TUB, Signatur USH-305</li> <li>Solid Waste Technology and Management. Thomas Christensen (Ed.), ISBN: 978-1-4051-7517-3, Wiley Verlag Lesesaal 2: US - Umweltschutz, Signatur USH-332</li> <li>Natural attenuation of fuels and chlorinated solvents in the subsurface. Todd H. Wiedemeier(Ed.), ISBN: 0471197491 Lesesaal 2: US - Umweltschutz, Signatur USH-844</li> </ol>

Course L0907: Contaminated	rse L0907: Contaminated Sites and Landfilling		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Dr. Marco Ritzkowski, Dr. Joachim Gerth		
Language	EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L0904: Geochemical	Engineering
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Joachim Gerth
Language	EN
Cycle	SoSe
	As an introduction cases are presented in which geochemical engineering was used to solve environmental problems. Environmentally important minerals are discussed and methods for their detection. It is demonstrated how solution equilibria can be modified to eliminate elevated concentrations of unwanted species in solution and how carbon dioxide concentration affects pH and the dissolution of carbonate minerals. Modifications of redox conditions, pH, and electrolyte concentration are shown to be effective tools for controlling the mobility and fate of hazardous species in the environment.
Literature	Geochemistry, groundwater and pollution. C. A. J. Appelo; D. Postma Leiden [u.a.] Balkema 2005
	Lehrbuchsammlung der TUB, Signatur GWC-515

Courses				
		<b>T</b>	Line (colo	<b>CD</b>
<b>Title</b> Smart Monitoring (L2762)		Typ Integrated Lecture	Hrs/wk	<b>CP</b> 2
Smart Monitoring (L2762) Smart Monitoring (L2763)		Recitation Section (small)	2	4
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
	Basic knowledge or interest in object-oriented modeling	, programming, and sensor technol	ogies are helpful	I. Interest in mode
Knowledge	research and teaching areas, such as Internet of Things, skills of scientific working, are required. Basic knowledge			s the will to deep
Educational Objectives	After taking part successfully, students have reached the	following learning results		
<b>Professional Competence</b>				
	The students will become familiar with the principles a decentralized smart systems to be applied for contine environment. In addition, the students will learn to design analysis techniques, modern software design concepts, an also part of this module. In small groups, the studen "intelligent" sensors to be implemented by the studer techniques. The smart monitoring systems will be mount on scaled lab structures for validation purposes. The out module will "automatically" participate with their smart written papers and oral examinations form the final grade	uous (remote) monitoring of system n and to implement intelligent sense nd embedded computing methodolo ts will design smart monitoring s nts. Specific focus will be put on ed on real-world (built or natural) sy come of every group will be docum a monitoring system in the annual	ms in the built or systems using gies. Besides lect ystems that inte the application ystems, such as ented in a paper "Smart Monitorir	and in the natu state-of-the-art da tures, project work egrate a number of machine learn bridges or slopes, r. All students of t ng" competition.
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written 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 Engineering			
	Civil Engineering: Specialisation Coastal Engineering: Elec			
	Civil Engineering: Specialisation Structural Engineering: E	, ,		
	Civil Engineering: Specialisation Coastal Engineering: Elec	tive Compulsory		
	Civil Engineering: Specialisation Geotechnical Engineering			
	Civil Engineering: Specialisation Structural Engineering: E			
	Civil Engineering: Specialisation Water and Traffic: Electiv			
	Environmental Engineering: Specialisation Waste and Ene			
	Environmental Engineering: Specialisation Biotechnology:			
	Environmental Engineering: Specialisation Water: Elective			
	Environmental Engineering: Specialisation Waste and Ene			
	Environmental Engineering: Specialisation Biotechnology:			
	Environmental Engineering: Specialisation Water: Elective			
	Water and Environmental Engineering: Specialisation Citie			
	Water and Environmental Engineering: Specialisation Citie			
	Water and Environmental Engineering: Specialisation Env	ironment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Env Water and Environmental Engineering: Specialisation Wat	ironment: 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	WiSe/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	

Course 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	WiSe/SoSe
Content	The contents of the exercises are based on the lecture contents. In addition to the exercises, project work will be conducted, 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.
Literature	

Courses						
Title				•	Line /usik	СР
Waste and Environmental Chemist	ny (L0328)		Tyj	o ctical Course	Hrs/wk 2	2
Biological Waste Treatment (L031)	-			ject-/problem-based Learning	3	4
Module Responsible				,p	-	
Admission Requirements						
Recommended Previous		l basics				
Knowledge	chemical and biologica	1 503103				
Educational Objectives	After taking part succe	sefully students have	eached the following le	arning results		
Professional Competence	Arter taking part succe	ssidily, students have i	cachea the following it	arming results		
		•		ogical waste treatment plan		
				n detail, describe different to thods for waste analytics.	echniques for v	waste gas treatmo
Skills	control measurements.	. The students can rec	herché and evaluate lit	t of plants. They can critical cerature and date connected ng findings in the group.		
Personal Competence Social Competence	Students can participa	of others and promote		cussions, develop cooperate ment in front of colleagues		
Autonomy	are capable, in consult	ation with supervisors a rthermore, they can d	as well as in the interim efine targets for new a	s or test reports and transfo presentation, to assess the pplication-or research-orien	ir learning lev	el and define furt
Workload in Hours	Independent Study Tim	ne 110, Study Time in L	ecture 70			
Workload in Hours Credit points		ne 110, Study Time in L	ecture 70			
	6 Compulsory Bonus Yes None	e 110, Study Time in L Form Subject theoretical practical work	ecture 70 Description and			
Credit points Course achievement	6 Compulsory Bonus Yes None	Form Subject theoretical	Description			
Credit points Course achievement	6 Compulsory Bonus Yes None	Form Subject theoretical practical work	Description and			
Credit points Course achievement Examination Examination duration and scale	6 Compulsory Bonus Yes None Presentation Elaboration and Presen	Form Subject theoretical practical work itation (15-25 minutes	Description and in groups)	npulsory		
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 Compulsory Bonus Yes None Presentation Elaboration and Presen Civil Engineering: Spec	Form Subject theoretical practical work itation (15-25 minutes ialisation Structural En	Description and in groups) gineering: Elective Com			
Credit points Course achievement Examination Examination duration and scale	6 Compulsory Bonus Yes None Presentation Elaboration and Presen Civil Engineering: Spec Civil Engineering: Spec	Form Subject theoretical practical work itation (15-25 minutes ialisation Structural En ialisation Geotechnical	Description and in groups) gineering: Elective Corr Engineering: Elective C	Compulsory		
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 Compulsory Bonus Yes None Presentation Elaboration and Presen Civil Engineering: Spec Civil Engineering: Spec Civil Engineering: Spec	Form Subject theoretical practical work itation (15-25 minutes ialisation Structural En ialisation Geotechnical ialisation Coastal Engir	Description and in groups) gineering: Elective Com Engineering: Elective Compu-	Compulsory Ilsory		
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 Compulsory Bonus Yes None Presentation Elaboration and Presen Civil Engineering: Spec Civil Engineering: Spec Civil Engineering: Spec Civil Engineering: Spec	Form Subject theoretical practical work itation (15-25 minutes ialisation Structural En ialisation Geotechnical ialisation Coastal Engir ialisation Water and Tr	Description and in groups) gineering: Elective Com Engineering: Elective Compu- affic: Elective Compulso	ompulsory ilsory ory	nulsory	
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 Compulsory Bonus Yes None Presentation Elaboration and Presen Civil Engineering: Spec Civil Engineering: Spec Civil Engineering: Spec Civil Engineering: Spec Energy and Environme	Form Subject theoretical practical work itation (15-25 minutes ialisation Structural En ialisation Geotechnical ialisation Coastal Engir ialisation Water and Tr ntal Engineering: Speci	Description and in groups) gineering: Elective Com Engineering: Elective Compu- affic: Elective Compulso alfic: Elective Compulso alisation Environmenta	Compulsory Ilsory	pulsory	
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 Compulsory Bonus Yes None Presentation Elaboration and Presen Civil Engineering: Spec Civil Engineering: Spec Civil Engineering: Spec Civil Engineering: Spec Energy and Environme Environmental Engineer	Form Subject theoretical practical work itation (15-25 minutes ialisation Structural En ialisation Geotechnical ialisation Coastal Engir ialisation Water and Tr ntal Engineering: Speci ring: Core qualification	Description and in groups) gineering: Elective Com Engineering: Elective Compu affic: Elective Compulso alisation Environmenta : Compulsory	compulsory Ilsory ory I Engineering: Elective Comp		Compulsory
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 Compulsory Bonus Yes None Presentation Elaboration and Presen Civil Engineering: Spec Civil Engineering: Spec Civil Engineering: Spec Civil Engineering: Spec Civil Engineering: Spec Energy and Environme Environmental Enginee International Managem	Form Subject theoretical practical work itation (15-25 minutes ialisation Structural En- ialisation Geotechnical ialisation Coastal Engir ialisation Water and Tr ntal Engineering: Speci ring: Core qualification tent and Engineering: S	Description and in groups) gineering: Elective Com Engineering: Elective C leering: Elective Compuls affic: Elective Compuls alisation Environmenta : Compulsory pecialisation II. Energy	compulsory ulsory ory I Engineering: Elective Comp and Environmental Enginee	ring: Elective (	1
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 Compulsory Bonus Yes None Presentation Elaboration and Presen Civil Engineering: Spec Civil Engineering: Spec Civil Engineering: Spec Civil Engineering: Spec Civil Engineering: Spec Energy and Environme Environmental Enginee International Managem Joint European Master	Form Subject theoretical practical work itation (15-25 minutes ialisation Structural En- ialisation Geotechnical ialisation Coastal Engir ialisation Water and Tr ntal Engineering: Speci ering: Core qualification eent and Engineering: S in Environmental Studio	Description and in groups) gineering: Elective Com Engineering: Elective C ieering: Elective Compuls affic: Elective Compuls alisation Environmenta : Compulsory pecialisation II. Energy es - Cities and Sustaina	compulsory ulsory I Engineering: Elective Comp and Environmental Enginee bility: Specialisation Energy:	ring: Elective (	1 5
Credit points Course achievement Examination Examination duration and scale Assignment for the	6 Compulsory Bonus Yes None Presentation Elaboration and Presen Civil Engineering: Spec Civil Engineering: Spec Civil Engineering: Spec Civil Engineering: Spec Civil Engineering: Spec Energy and Environme Environmental Enginee International Managem	Form Subject theoretical practical work itation (15-25 minutes i ialisation Structural En- ialisation Geotechnical ialisation Coastal Engir ialisation Water and Tr ntal Engineering: Speci ering: Core qualification eent and Engineering: S in Environmental Studie tal Engineering: Specia	Description and in groups) gineering: Elective Com Engineering: Elective Compuls affic: Elective Compuls alisation Environmenta : Compulsory pecialisation II. Energy es - Cities and Sustaina lisation Cities: Elective	compulsory ulsory I Engineering: Elective Comp and Environmental Enginee bility: Specialisation Energy: Compulsory	ring: Elective (	1 2

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	DE/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	<ol> <li>Introduction</li> <li>biological basics</li> <li>determination process specific material characterization</li> <li>aerobic degradation ( Composting, stabilization)</li> <li>anaerobic degradation (Biogas production, fermentation)</li> <li>Technical layout and process design</li> <li>Flue gas treatment</li> <li>Plant design practical phase</li> </ol>
Literature	

Courses				
Title		Тур	Hrs/wk	СР
Subsoil and Underground Engineer	ng Law (L0395)	Lecture	2	2
Service Contract and Procurement	Law (L1906)	Lecture	2	2
Project Geotechnics (L0708)		Project-/problem-based Learning	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	30 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Elective Co	ompulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elect	ive Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elective	Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Com			

Course L0395: Subsoil and U	nderground Engineering Law
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Günther Schalk
Language	DE
Cycle	WiSe
Content	History of Civil Engineering Law (from 1700 BC to 2000 AD)
	• Basics of foundation and excarvation law / engineering law (the participants in the case law of geotechnical law case studies)
	Legal aspects of technical regulations in civil engineering (with case studies)
	• The civil engineering contract (including checklists for the special civil engineering contract design and execution)
	• The liability of the planner and entrepreneur in civil engineering (practical examples, jurisprudence and law, inter alia, to the Ordinance on Combatants, liability for defects and traffic safety obligations, construction law and insurance questions)
	• The ground / foundation risk and the systemic risk (also in the European context)
	The total debt in (low) building law (based on practice-oriented case constellations)
	• The (construction) conflict, the dispute avoidance models and the construction process (practice-oriented presentation)
Literature	Folienskript (in der Vorlesung erhältlich)
	weitere Literatur:
	Englert, Grauvogel und Maurer: Handbuch des Baugrund- und Tiefbaurechts. Werner-Verlag

Course L1906: Service Contract and Procurement Law	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Günther Schalk, Prof. Jürgen Grabe
Language	DE
Cycle	WiSe
Content	
Literature	

Course L0708: Project Geote	chnics
Тур	Project-/problem-based Learning
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	The students solve independently a project-based geotechnical problem in groups. Additional lectures concerning the problem will
	be held and material will be distributed as study basis. Every two weeks the groups present their current project status. The final
	work will be presentated in a final presentation.
Literature	abhängig von der Fragestellung

Module M1716: Subs	urface Processes			
Courses				
Title		Тур	Hrs/wk	СР
Modeling of Subsurface Processes	L2730)	Lecture	2	2
Modeling of Subsurface Processes	L2731)	Recitation Section (small)	1	1
Modern Techniques for Subsurface		Lecture	2	2
Modern Techniques for Subsurface		Recitation Section (large)	1	1
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
	Independent Study Time 96, Study Time in Lect	ure 84		
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engi	neering: Elective Compulsory		
-	Civil Engineering: Specialisation Geotechnical E			
-	Civil Engineering: Specialisation Coastal Engine			
	Civil Engineering: Specialisation Water and Traf	fic: Elective Compulsory		
	Process Engineering: Specialisation Environmen	tal Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Eng	ineering: Elective Compulsory		
	Water and Environmental Engineering: Specialis	sation Water: Compulsory		
	Water and Environmental Engineering: Specialis	ation Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialis	ation Cities: Elective Compulsory		

Course L2730: Modeling of Subsurface Processes		
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Alexandru Tatomir	
Language	EN	
Cycle	WiSe	
Content		
Literature		

Course L2731: Modeling of S	urse L2731: Modeling of Subsurface Processes		
Тур	Recitation Section (small)		
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		

Course L2728: Modern Techr	urse L2728: Modern Techniques for 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			
Literature			

Course L2729: Modern Techr	ourse L2729: Modern Techniques for 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		

Courses				
Title		Түр	Hrs/wk	СР
Microplastics in Environment (L275		Integrated Lecture	PITS/WK 2	2
Research Methods for Energy-Wate		Lecture	1	2
Research Trends in Energy-Water-S	oil-Climate Nexus (L2752)	Seminar	2	2
Module Responsible	Prof. Nima Shokri			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge				
Educational Objectives	After taking part successfully, students have r	eached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in L	ecture 70		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Report (about 5-10 pages) and Presentation (a	about 15 min)		
scale				
Assignment for the	Civil Engineering: Specialisation Water and Tr	affic: Elective Compulsory		
Following Curricula	Environmental Engineering: Specialisation Wa	ter: Elective Compulsory		
	Environmental Engineering: Specialisation Wa	ste and Energy: Elective Compulsory		
	Environmental Engineering: Specialisation Bio			
	Water and Environmental Engineering: Specia			
	Water and Environmental Engineering: Specia	, ,		
	Water and Environmental Engineering: Specia	lisation Water: Elective Compulsory		

Course L2750: Microplastics	urse L2750: Microplastics in Environment		
Тур	Integrated 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			
Literature			

Course L2751: Research Methods for Energy-Water-Soil-Climate Nexus	
Тур	Lecture
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Nima Shokri
Language	EN
Cycle	WiSe
Content	
Literature	

Course L2752: Research Trends in Energy-Water-Soil-Climate Nexus		
Тур	Seminar	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Nima Shokri, Dr. Alexandru Tatomir	
Language	EN	
Cycle	WiSe	
Content		
Literature		

Courses					
Title		Тур	Hrs/wk	СР	
	es Oriented Sanitation for different Climate Zones (L0942)	Seminar	2	3	
Rural Development and Resource	es Oriented Sanitation for different Climate Zones (L0941)	Lecture	2	3	
Module Responsibl	e Prof. Ralf Otterpohl				
Admission Requirement	s None				
Recommended Previou	Basic knowledge of the global situation with rising poverty, soil degradation, lack of water resources and sanitation			ation	
Knowledg	e				
Educational Objective	After taking part successfully, students have reached the following learning results				
Professional Competence	e				
Knowledg	e Students can describe resources oriented wastewater s	stems mainly based on sou	irce control in detail. Th	ney can comment	
	techniques designed for reuse of water, nutrients and soi	conditioners.			
	Students are able to discuss a wide range of proven appr	paches in Bural Development	from and for many regi	ions of the world	
	stadents are able to discuss a wide range of proven appr	suches in Rural Development	in only reg		
Skil	s Students are able to design low-tech/low-cost sanitation, rural water supply, rainwater harvesting systems, measures for th				
	rehabilitation of top soil quality combined with food and water security. Students can consult on the basics of soil building throug				
	"Holisitc Planned Grazing" as developed by Allan Savory.				
Personal Competence	e				
	The students are able to develop a specific topic in a team and to work out milestones according to a given plan.				
<i>p</i>					
Autonom	/ Students are in a position to work on a subject and to organize their work flow independently. They can also present on thi				
	subject.				
Workload in Hou	s Independent Study Time 124, Study Time in Lecture 56				
Credit point	<b>is</b> 6				
Course achievemer	t None				
Examinatio	n Subject theoretical and practical work				
Examination duration an		wards mile stones. The work	includes presentations	and papers. Detail	
	e information will be provided at the beginning of the smes				
Assignment for th					
Following Curricul			ompulsory		
U U	Chemical and Bioprocess Engineering: Specialisation Gen				
	Energy and Environmental Engineering: Specialisation En	ergy and Environmental Engi	neering: Elective Comp	ulsory	
	Environmental Engineering: Specialisation Water: Elective	•••	- '	-	
	International Management and Engineering: Specialisatio	n II. Energy and Environment	al Engineering: Elective	Compulsory	
	Joint European Master in Environmental Studies - Cities a	nd Sustainability: Specialisati	on Water: Elective Com	pulsory	
	Process Engineering: Specialisation Environmental Proces	s Engineering: Elective Comp	oulsory		
	Process Engineering: Specialisation Process Engineering:	Elective Compulsory			
	Water and Environmental Engineering: Specialisation Wa	er: Elective Compulsory			
	Water and Environmental Engineering: Specialisation Environmental	ironment: Elective Compulso	ry		
	Water and Environmental Engineering: Specialisation Citi	s. Flastiva Compulsory			

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	<ul> <li>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.</li> <li>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.</li> </ul>
Literature	<ul> <li>J. Lange, R. Otterpohl 2000: Abwasser - Handbuch zu einer zukunftsfähigen Abwasserwirtschaft. Mallbeton Verlag (TUHH Bibliothek)</li> <li>Winblad, Uno and Simpson-Hébert, Mayling 2004: Ecological Sanitation, EcoSanRes, Sweden (free download)</li> <li>Schober, Sabine: WTO/TUHH Award winning Terra Preta Toilet Design: http://youtu.be/w_R09cYq6ys</li> </ul>

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

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			
<b>Recommended Previous</b>	Knowledge of the most important processes	in drinking water and waste water treatment.		
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	Students are able to explain selected proce basics as well as possibilities and limitations	sses of drinking water and waste water treatment i of dynamic modeling.	n detail. The	y are able to expla
Skills		t features Modelica offers. They are able to transpo thematical model in Modelica with respect to equilib d assess their possibilities and limitations.		
Personal Competence Social Competence	Students are able to solve problems and do	cument solutions in a group with members of differe ork constructively with feedback concerning their wo		ackground. They a
Autonomy	Students are able to define a problem, gain	the required knowledge and set up a model.		
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	1,5 hours			
scale				
Assignment for the	Civil Engineering: Specialisation Water and T	raffic: Elective Compulsory		
Following Curricula	Environmental Engineering: Specialisation W	ater: Elective Compulsory		
	Joint European Master in Environmental Stud	lies - Cities and Sustainability: Specialisation Water: I	Elective Comp	oulsory
	Process Engineering: Specialisation Environm	nental Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process	Engineering: Elective Compulsory		
	Water and Environmental Engineering: Spec	ialisation Water: Elective Compulsory		
	Water and Environmental Engineering: Spec	ialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Spec	ialisation 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
	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/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	<ul> <li>OpenModelica: https://openmodelica.org/index.php/download/download-windows</li> <li>OpenModelica - Modelica Tutorial: https://openmodelica.org/index.php/useresresources/userdocumentation</li> <li>OpenModelica - Users Guide: https://openmodelica.org/index.php/useresresources/userdocumentation</li> <li>Peter Fritzson: Principles of Object-Oriented Modeling and Simulation with Modelica 2.1,Wiley-IEEE Press, ISBN 0-471-471631.</li> <li>MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John Wiley &amp; Sons, Hoboken, 2005.</li> <li>Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley &amp; Sons, New York, 1996.</li> <li>DVGW (Hrsg.): Wasseraufbereitung - Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004.</li> </ul>

Courses						
				<b>T</b>	Une (colo	<b>CD</b>
Title	Managamanh (11055)	\ \		Typ	Hrs/wk	<b>СР</b> 3
Advanced Topics in Waste Resourc nternational Waste Management (	-	)		Project-/problem-based Learning Project-/problem-based Learning	3 2	3
				Project-/problem-based Learning	Z	2
Module Responsible Admission Requirements		I				
		tmont tochnologies				
Kecommended Previous Knowledge	basics in waste treatment technologies					
0						
Educational Objectives		ccessfully, students hav	e reached the followi	ng learning results		
Professional Competence						<i>.</i>
Knowledge				as advanced technologies for re		
	from waste in detail	I. This covers collection,	transport, treatment	and disposal in national and int	ernational con	texts.
Skills	Students are able to select suitable processes for the treatment with respect to the national or cultural and developmental context					
	They can evaluate the ecological impact and the technical effort of different technologies and management systems.					
	.,					
Personal Competence						
Social Competence	Students can work	together as a team of	2-5 persons, partici	pate in subject-specific and inte	erdisciplinary	discussions, dev
	cooperated solution	is and defend their owr	n work results in from	t of others and promote the sci	entific develo	pment of colleag
	Furthermore, they c	an give and accept pro	fessional constructive	criticisms.		
Autonomy	Students can inden	endently gain addition	al knowledge of the	subject area and apply it in se	olving the giv	on course tasks
Autonomy		pendently gain addition	al knowledge of the	subject area and apply it in so	olving the giv	en course tasks
Autonomy	Students can indep projects.	pendently gain addition	al knowledge of the	subject area and apply it in so	olving the giv	en course tasks
Autonomy Workload in Hours	, projects.	pendently gain addition	5	subject area and apply it in so	olving the giv	en course tasks
	projects.		5	subject area and apply it in so	olving the giv	en course tasks
Workload in Hours	projects. Independent Study <sup>-</sup> 6		5	subject area and apply it in so	olving the giv	en course tasks
Workload in Hours Credit points	projects. Independent Study <sup>-</sup> 6	Time 110, Study Time i	n Lecture 70	subject area and apply it in so	olving the giv	en course tasks
Workload in Hours Credit points Course achievement	projects. Independent Study 7 6 Compulsory Bonus	Time 110, Study Time in	n Lecture 70	subject area and apply it in so	olving the giv	en course tasks
Workload in Hours Credit points Course achievement	projects. Independent Study <sup>1</sup> 6 Compulsory Bonus Yes 20 % Presentation	Time 110, Study Time i Form Written elaboration	n Lecture 70	subject area and apply it in so	olving the giv	en course tasks
Workload in Hours Credit points Course achievement Examination	projects. Independent Study <sup>1</sup> 6 Compulsory Bonus Yes 20 % Presentation	Time 110, Study Time i Form Written elaboration	n Lecture 70	subject area and apply it in so	olving the giv	en course tasks
Workload in Hours Credit points Course achievement Examination Examination duration and scale	projects. Independent Study 7 6 Compulsory Bonus Yes 20 % Presentation PowerPoint presentat	Time 110, Study Time i Form Written elaboration	Description		olving the giv	en course tasks
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	projects. Independent Study 1 6 Compulsory Bonus Yes 20 % Presentation PowerPoint presenta Civil Engineering: Sp	Time 110, Study Time i Form Written elaboration ation (10-15 minutes)	Description Traffic: Elective Com	pulsory	olving the giv	en course tasks
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	projects. Independent Study 1 6 Compulsory Bonus Yes 20 % Presentation PowerPoint presentat Civil Engineering: Sp Environmental Engin	Time 110, Study Time i Form Written elaboration ation (10-15 minutes) pecialisation Water and neering: Specialisation	Description Traffic: Elective Com	pulsory		
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	projects. Independent Study 1 6 Compulsory Bonus Yes 20 % Presentation PowerPoint presentat Civil Engineering: Sp Environmental Engin Joint European Mast	Time 110, Study Time i Form Written elaboration ation (10-15 minutes) pecialisation Water and neering: Specialisation	Description Traffic: Elective Comp Waste and Energy: Elective Souther South	oulsory ective Compulsory ainability: Specialisation Energy		
Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	projects. Independent Study 1 6 Compulsory Bonus Yes 20 % Presentation PowerPoint presentat Civil Engineering: Sp Environmental Engi Joint European Mast Water and Environment	Time 110, Study Time i Form Written elaboration ation (10-15 minutes) pecialisation Water and neering: Specialisation ' ter in Environmental Stu- nental Engineering: Specialisation '	Description Traffic: Elective Comp Waste and Energy: Elective Sust idies - Cities and Sust cialisation Water: Elective	oulsory ective Compulsory ainability: Specialisation Energy		

Course L1055: Advanced Top	oics in Waste Resource Management
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	WiSe
Content	<ul> <li>Focus of the course "Advanced topics of waste resource management" lies on the organisational structures in waste management - such as planning, financing and logistics. One excursion will be offered to take part in (incineration plant, vehicle fleet and waste collection systems).</li> <li>The course is split into two parts: <ol> <li>part: "Conventional" lecture (development of waste management, legislation, collection, transportation and organisation of waste management, costs, fees and revenues).</li> <li>part: Project base learning: You will get a project to work out in groups of 4 to 6 students; all tools and data you need to work out the project were given before during the conventional lecture. Course documents are published in StudIP and communication during project work takes place via StudIP.</li> </ol> </li> <li>The results of the project work are presented at the end of the semester. The final mark for the course consists of the grade for the presentation.</li> </ul>
Literature	Einführung in die Abfallwirtschaft; Martin Kranert, Klaus Cord-Landwehr (Hrsg.); Vieweg + Teubner Verlag; 2010 PowerPoint slides in Stud IP

Course L0317: International	Waste Management
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Kerstin Kuchta
Language	EN
Cycle	WiSe
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

Courses					
Title			Тур	Hrs/wk	СР
Concrete Structures (L0579)		Seminar	1	1	
Structural Concrete Members (L0577)			Lecture	2	3
Structural Concrete Members (L05			Recitation Section (large)	2	2
Module Responsible	Prof. Günter Romba	ich			
Admission Requirements	None				
<b>Recommended Previous</b>	Basics of structural	analysis, conception and	d dimensioning of structural concrete		
Knowledge	Modules: Reinforcer	d Concrete Structures L	II, Structural Analysis I+II, Mechanics I+II		
	Modules. Reinforcee		n, structural Analysis Frin, Mechanics Frin		
Educational Objectives	After taking part suc	ccessfully, students hav	e reached the following learning results		
Professional Competence					
Knowledge	e The students broaden their skills in structural engineering, especially in the field of buildings (houses, roofs, halls). They			alls). They dispos	
	the knowledge for the	he conception and desig	n of concrete buildings and structural membe	ers that are often use	d.
Skills	It is students are able to apply procedures of the conception and dimensioning to to practical problems of structural			ructural engineer	
	They are capable to draft concrete buildings and to design them for general action effects and to plan their detailing an				
	execution. Moreove	r, they can make design	and construction sketches and draw up tech	nical descriptions.	
Personal Competence					
-		ole to obtain results of hi	igh quality in teamwork		
Social competence	The students are as				
Autonomy	The students are ab	ble to carry out complex	conception and dimensioning tasks of structu	res under the guidan	ce of tutors.
Werkland in Hours	Indonandant Study	Time 110, Study Time ir	a Lastura 70		
Credit points		Time 110, Study Time II			
create points		Form	Description		
Course achievement		Presentation	Es werden 2 Referate ausgegeben		
Course achievement	Yes None				
	Yes None Written exam				
Examination	Written exam				
	Written exam				
Examination Examination duration and scale	Written exam 120 minutes	pecialisation Structural I	Engineering: Compulsory		
Examination Examination duration and scale Assignment for the	Written exam 120 minutes Civil Engineering: Sp		Engineering: Compulsory al Engineering: Elective Compulsory		
Examination Examination duration and scale	Written exam 120 minutes Civil Engineering: Sp Civil Engineering: Sp	pecialisation Geotechnic	al Engineering: Elective Compulsory		
Examination Examination duration and scale Assignment for the	Written exam 120 minutes Civil Engineering: Sr Civil Engineering: Sr Civil Engineering: Sr	pecialisation Geotechnic pecialisation Coastal Eng			

Course L0579: Concrete Stru	ourse L0579: Concrete Structures		
Тур	Seminar		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Günter Rombach		
Language	DE		
Cycle	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.		

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

Course L0578: Structural Co	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	Prof. Günter Rombach		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Courses							
Fitle	Chryseburges			Тур		Hrs/wk	СР
Computational Analysis of Concrete Computational Analysis of Concrete				Lecture Recitation Sec	tion (large)	2 1	3 1
E-Modeling of Concrete Structures		(L0399)			em-based Learning	2	2
Module Responsible		er Romba	ch		5		
-	None						
<b>Recommended Previous</b>	Basic know	ledge in :	structural analysis and	design of reinforced concrete struct	ures (beams, slab	s, shear walls)	
Knowledge	Lectures '	Concrete	Structures I und II'				
	Lectures 's	Structural	Analysis I and II'				
	Lecture 'Co	oncrete St	ructures'				
	Lecture et	Sherete St	indetures				
Educational Objectives	After taking part successfully, students have reached the following learning results						
<b>Professional Competence</b>							
Knowledge	The students know the problems of numerical modeling and design of an arbitrary concrete structure.						
Skills	The students can model and design an arbitrary concrete structure by means of a finite element software package.						
Personal Competence							
Social Competence	The students can model and design in teamwork a real concrete structure by means of a finite element software package.						
Autonomy	The students can model and design a real concrete structure based on a finite element software package and discuss the probler and results with other students.						
Workload in Hours	Independe	nt Study <sup>-</sup>	Fime 110, Study Time i	n Lecture 70			
	6	,					
Course achievement	Compulsory	Bonus	Form	Description			
	Yes	None	Excercises	Es ist ein Tragsystem mit T	EDDY zu modellier	ren	
	Yes	None	Attestation	Am Ende des Semster is	st ein Tragsystem	n mit dem R	echenprogramm z
				modellieren			
Examination	Oral exam						
Examination duration and	45 min						
scale							
Assignment for the	Civil Engin	eering: Sp	ecialisation Structural	Engineering: Elective Compulsory			
Following Curricula	Civil Engin	eering: Sp	ecialisation Geotechni	cal Engineering: Elective Compulsor	У		
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory						

Course L0598: Computationa	Il Analysis of Concrete Structures
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	WiSe
Content	<ul> <li>Modeling of beam and truss structures <ul> <li>Discontinuity regions, like frame corners, openings, shear walls with large openings</li> <li>Bracing of high-rise buildings</li> <li>Modeling of bridges</li> <li>Nonlinear analysis</li> </ul> </li> <li>Finite-Elemente-analysis of slabs: support conditions, singularity regions</li> <li>Finite-Elemente-Berechnungen of shear walls and deep beams: support condition, design</li> <li>Coupled systems</li> <li>Modeling of slab supported on beams</li> <li>Shell structures</li> <li>3D building models</li> <li>Nonlinear analysis of slabs and shells</li> <li>Documentation</li> </ul>
Literature	<ul> <li>Vorlesungsumdruck</li> <li>Rombach, G.A. (2007): Anwendung der Finite-Elemente-Methode im Betonbau. 2. Auflage, Verlag Ernst &amp; Sohn, Berlin</li> <li>Rombach G.A. (2011): Finite-Element Design of Concrete Structures, 2nd edition, ICE publishing</li> <li>Hartmann, F., Katz, C. (2002): Statik mit finiten Elementen. Springer, Berlin</li> </ul>

Course L0599: Computationa	urse L0599: Computational Analysis of Concrete Structures		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Günter Rombach		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L0600: FE-Modeling o	of Concrete Structures
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Lukas Henze
Language	DE
Cycle	WiSe
Content	Finite Element Modeling and computational design of concrete structures by 'SOFiSTiK'
Literature	<ul> <li>Rombach G.: Anwendung der Finite - Elemente - Methode im Betonbau. 2. Auflage. Verlag Ernst &amp;.Sohn, Berlin, 2007</li> <li>Rombach G.: Finite-Element Design of Concrete Structures. 2nd edition, ICE Publishing, London, 2011, ISBN 0 7277 32749</li> <li>Rombach G.: EDV-unterstützte Berechnungen im Stahlbetonbau. in: "Stahlbetonbau aktuell 2014" (ed. Gorris A., Hegger J., Mark P.), Berlin 2014 (S. C1C.36)</li> </ul>

Modulo M0062, 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 Knowledge	Basics of steel construction (i.e. Steel Structures I and II, BUBC)			
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence	Arter taking part successibility, students have reached the follow	ing learning results		
	After successful completition, students can			
Kilowicage	And Succession completition, statients can			
	<ul> <li>describe the phenomenon of local buckling</li> </ul>			
	<ul> <li>explain warping torsion</li> </ul>			
	<ul> <li>illustrate the behaviour of composite structures</li> </ul>			
	<ul> <li>specify the principles in design of composite sttructures</li> </ul>			
	sketch the contructions of steel and composite bridges			
Skills	After successful participation students are able to			
	check stiffened and unstiffened plated structures			
	<ul> <li>recognize and verify warping tosion in strucures</li> </ul>			
	<ul> <li>design composite structures</li> </ul>			
	design bridges and o perform the detailing			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Comput	lsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elec	tive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective C	ompulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Com	npulsory		
	International Management and Engineering: Specialisation II. Ci	vil Engineering: Elective Com	oulsory	

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	<ul> <li>Local-buckling of plated structures</li> <li>Warping torsion</li> <li>Composite-girders, -columns, -slabs, -bridges</li> <li>Principles in composite constructions</li> <li>Bridge-design and -construction</li> </ul>
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	urse 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
	Dr. Jörg Ahlgrimm
Language	
Cycle	
Content	Lecture Contents ,Steel Bridge Construction' DrIng. Jörg Ahlgrimm
	<ul> <li>From tendering and contracting to completion - the development of a steel bridge</li> <li>Contents of a bridge static - structural details, examples of analysis in detail:</li> </ul>
	-> 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	
	<ul> <li>Herbert Schmidt, Ulrich Schulte, Rainer Zwätz, Lothar Bär: Ausführung von Stahlbauten</li> <li>Petersen, Christian: Stahlbau, Abschnitt Brückenbau</li> </ul>
	<ul> <li>Ahlgrimm, J., Lohrer, I.: Erneuerung der Eisenbahnüberführung in Fulda-Horas über die Fulda, Stahlbau 74 (2005), Heft 2, S.</li> <li>114</li> </ul>

<ul> <li>Students are able to interrelate scientific and technical knowledge.</li> <li>Skills</li> <li>Students are able to apply basic methods in selected areas of civil and structural engineering.</li> <li>Personal Competence Autonomy</li> <li>Students can chose independently, in which fields they want to deepen their knowledge and skills through the ele courses.</li> <li>Workload in Hours</li> <li>Depends on choice of courses</li> <li>Credit points</li> <li>Civil Engineering: Specialisation Structural Engineering: Elective Compulsory</li> <li>Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory</li> </ul>	Module M0969: Select	ted Topics in Civil Engineering			
Ergonomics (L0533) Lecture 2 3 Analysis of Offshore Structures (L1867) Lecture 2 3 Analysis of Offshore Structures (L1867) Lecture 1 1 1 Excellence in international Project Delivery (L2387) Integrated Lecture 2 2 Design of Prefabricated Concrete Structures (L0596) Lecture 1 1 Forum 1 - Gestechnics and Construction Management (L1634) Seminar 1 1 Forum 1 - Gestechnics and Construction Management (L1635) Seminar 2 2 Timber Structures (L0596) Lecture 2 3 Gestechnical Engineering Design (L2447) Lecture 2 3 Giass Structures (L1515) Lecture 2 2 Giass Structures (L1526) Lecture 2 3 Giass Structures (L1512) Lecture 2 2 Giass Structures (L1512) Lecture 2 2 Giass Structures (L1512) Lecture 2 2 Seminar 2 2 Giass Structures (L147) Reclatation Section (large) 1 Testing and non-destruction examination of concrete members (L2725) Project-/groblem-based Learning 2 Special topics of civil engineering 2 LP (L2379) 2 Special topics of civil engineering 2 LP (L2379) 2 Special topics of civil engineering 2 LP (L2379) 2 Seminar 2 2 Module Responsible Prof. Frank Schmidt-Dohl Admission Requirements None Recommended Previous none Knowledge Fordersional Competence Social Competence Courses. Social Competence	Courses				
Analysis of Offshore Structures (L1867)       Lecture       1       1         Excelence in international Project Delivery (L287)       Integrated Lecture       2       2         Design of Prefabricated Concrets Structures (L0596)       Lecture       1       1         Design of Prefabricated Concrets Structures (L0596)       Recitation Section (large)       1       1         Forum 1 - ceetechnics and Construction Management (L1635)       Seminar       2       2         Genetic Analysis of Construction (L2666)       Lecture       2       3         Timber Structures (L1151)       Seminar       2       2         Innovitive Timber Construction (L2666)       Lecture       2       3         Gass Structures (L1152)       Recitation Section (large)       1       1         Structures (L147)       Recitation Section (large)       1       1         Structures (L147)       Recitation Section (large)       1       1         Special topics of civil engineering 1 CP (L2378)       Z       2       2         Special topics of civil engineering 3 LP (L2379)       Seminar       2       2       2         Module Responsible       Prof. Frank Schmidt-Dohi       A       3       3         Structure Beign (L2769)       None       Structure Schm	Title	Тур	Hrs/wk	СР	
Excellance in International Project Delivery (12387)     Integrated Lecture     2     2       Design of Prelabinicated Concrete Structures (10597)     Reclation Section (large)     1     1       Form II - Geotechnics and Construction Management (11634)     Seminar     1     1       Form II - Geotechnics and Construction Management (11635)     Seminar     1     1       Geotechnical Engineering Design (1247)     Lecture     2     3       Timber Structures (1151)     Lecture     2     2       Innovadive Timber Construction (12666)     Lecture     2     2       Glass Structures (1137)     Reclation Section (large)     1     1       Testing and non-destructive examination of concrete members (12725)     Project / problem-based Learning     2     2       Special topics of civil engineering 2 LP (12378)     2     2     2       Special topics of civil engineering 3 LP (12380)     3     3     3       Structures (12729)     Seminar     2     2       Module Responsible     Prof. Frank Schnidt-Dohl	Ergonomics (L0653)	Lecture	2	3	
Design of Prefabricated Concrete Structures (L0596)       Lacture       1       1         Design of Prefabricated Concrete Structures (L0597)       Recitation Saction (large)       1       1         Form I - Geotechnics and Construction Management (L1633)       Seminar       1       1         Form I - Geotechnics and Construction Management (L1633)       Seminar       1       1         Geotechnical Engineering Design/intering Design/intering Design/intering Design/intering Design/intering Design (L2477)       Lecture       2       2         Innovative Timber Construction (L266)       Lecture       2       2       2         Glass Structures (L112)       Recitation Section (large)       1       1       1         Glass Structures (L127)       Recitation Section (large)       1       1       1         Structures (L132)       Recitation Section (large)       1       1       1         Structures (L147)       Recitation Section (large)       1       1       1       1         Special topics of civil engineering 2 LP (2378)       Recitation Section (large)       1       1       1         Special topics of civil engineering 2 LP (2378)       Seminar       2       2       2         Admission Requirements       None       None       Recommended Previous       non	Analysis of Offshore Structures (L18	367) Lecture	1	1	
Design of Prefabricated Concrete Structures (L0597)       Rectation Section (large)       1       1         Forum 1 - Geotechnics and Construction Management (L1634)       Seminar       1       1         Geotechnics and Construction Management (L1635)       Seminar       2       2         Geotechnics Ingineering Design (L2477)       Lecture       2       3         Inher Structures (L1152)       Lecture       2       2         Class Structures (L1477)       Rectation Section (large)       1       1         Testing and non-destructive examination of concrete members (L2725)       Project-/problem-based Learning       2       2         Special topics of civil engineering 2 LP (L2378)       2       2       2       2         Special topics of civil engineering 3 LP (L2380)       3       3       3       3         Structural Design (L2789)       Seminar       2       2       2         Module Responsible       Prof. Frank Schmidt-Dohl	Excellence in International Project	Delivery (L2387) Integrated Lecture	2	2	
Forum 1 - Gestechnics and Construction Management (L1634)     Seminar     1     1       Forum 1 - Gestechnics and Construction Management (L1635)     Seminar     1     1       Forum 1 - Gestechnics and Construction Management (L1635)     Seminar     1     1       Gestechnics and Construction Management (L1635)     Seminar     2     3       Timber Structures (L151)     Seminar     2     2       Innovative Timber Construction (L2666)     Lecture     2     3       Glass Structures (L1447)     Recitation Section (large)     1     1       Special topics of civil engineering 1CP (L2378)     Project-/problem-based Learning     2     2       Special topics of civil engineering 3 LP (L2380)     3     3     3       Structural Design (L2789)     Seminar     2     2       Module Responsible     Prof. Frank Schmidt-Dohl     Admission Requirements     None       Recommended Previous     None     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 explain basic models and procedures in selected special areas of civil and structural engineering.     Students are able to apply basic methods in selected areas of civil and structural engineering.       Personal Competence     Students are able	Design of Prefabricated Concrete S	tructures (L0596) Lecture	1	1	
Form 1 - Geotechnica and Construction Management (L1635)       Seminar       1       1         Geotechnica Engineering Design (L2447)       Lecture       2       3         Innovative Timber Construction (L2660)       Lecture       2       3         Gass Structures (L1152)       Lecture       2       2         Gass Structures (L1147)       Recitation Section (large)       1       1         Testing and non-destructive examination of concrete members (L2725)       Project-/problem-based Learning       2       2         Special topics of civil engineering 1CP (L2379)       2       2       2         Special topics of civil engineering 1CP (L2379)       3       3       3       3         Structural Design (L2789)       For Engineering 2       2       2       2         Module Responsible       Prof. Frank Schmidt-Dôhl       -       -       -       -         Admission Requirements       None       -	Design of Prefabricated Concrete S	tructures (L0597) Recitation Section (	large) 1	1	
Getechnical Engineering Design (L2447)       Lecture       2       3         Timber Structures (1151)       Seminar       2       2         Innovative Timber Construction (L2666)       Lecture       2       3         Glass Structures (1152)       Recitation Section (large)       1       1         Testing and non-destructive examination of concrete members (L2725)       Project-/problem-based Learning       2       2         Special topics of civil engineering 1CP (12378)       2       2       2         Special topics of civil engineering 3 LP (L2380)       3       3       3         Structural Design (L2748)       Seminar       2       2         Module Responsible       Prof. Frank Schmidt-Döhl       -       -         Admission Requirements       None       -       -         Recommended Previous Knowledge       none       -       -         Students are able to find their way through selected special areas of civil and structural engineering.       -       -         Students are able to apply basic methods in selected areas of civil and structural engineering.       -       -         Students are able to apply basic methods in selected areas of civil and structural engineering.       -       -         Students are able to apply basic methods in selected areas of civil and structura	Forum I - Geotechnics and Construct	ction Management (L1634) Seminar	1	1	
Timber Structures (L1151)       Seminar       2       2         Innovative Timber Construction (L2666)       Lecture       2       3         Glass Structures (L1152)       Lecture       2       2         Glass Structures (L1417)       Recitation Section (large)       1       1         Testing and non-destructive examination of concrete members (L2725)       Project-/problem-based Learning       2       2         Special topics of civil engineering 1CP (L2378)       2       2       2         Special topics of civil engineering 3 LP (L2379)       2       2       2         Special topics of civil engineering 3 LP (L2379)       3       3       3         Structural Design (L2789)       Seminar       2       2       2         Module Responsible       Prof. Frank Schmidt-Döhl       4       4       4       4       4       4       5       3       3       3         Browledge       None       Recommended Previous       none	Forum II - Geotechnics and Constru	ction Management (L1635) Seminar	1	1	
Innovative Timber Construction (L2666)       Lecture       2       3         Glass Structures (L152)       Lecture       2       2         Glass Structures (L147)       Recitation Section (large)       1       1         Testing and non-destructive examination of concrete members (L2725)       Project-/problem-based Learning       2       2         Special topics of civil engineering 2 LP (L2370)       3       3       3       3         Structures (L1789)       Seminar       2       2       2         Special topics of civil engineering 2 LP (L2370)       3       3       3       3         Structures (L2789)       Seminar       2       2       2         Module Responsible       Prof. Frank Schmidt-Dobl       Admission Requirements       None       Recommended Previous       none         Recommended Previous       none       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 explain basic models and procedures in selected special areas of civil and structural engineering.         Skills       Students are able to apply basic methods in selected areas of civil and structural engineering.       Students are able to apply basic methods in selected areas of civil and structural engine	Geotechnical Engineering Design (L	.2447) Lecture	2	3	
Glass Structures (L1152)       Lecture       2       2         Glass Structures (L1477)       Recitation Section (large)       1       1         Testing and non-destructive examination of concrete members (L2725)       Project-/problem-based Learning       2       2         Special topics of civil engineering 1CP (L2378)       1       1       1         Special topics of civil engineering 1CP (L2378)       2       2       2         Special topics of civil engineering 3 LP (L2390)       3       3       3         Structural Design (L2789)       Seminar       2       2         Module Responsible       Prof. Frank Schmidt-Dôhl	Timber Structures (L1151)	Seminar	2	2	
Glass Structures (L1447)       Recitation Section (large)       1       1         Testing and non-destructive examination of concrete members (L2725)       Project-/problem-based Learning       2       2         Special topics of civil engineering 1CP (L2378)       1       1       1         Special topics of civil engineering 3 LP (L2379)       2       2       2         Special topics of civil engineering 3 LP (L2380)       3       3       3         Structure Design (L2789)       Fronk Schmidt-Dohl       3       3         Module Responsible       Prof. Frank Schmidt-Dohl       Admission Requirements       None         Recommended Previous Knowledge       none	Innovative Timber Construction (L2	666) Lecture	2	3	
Testing and non-destructive examination of concrete members (L2725)       Project-/problem-based Learning 2       2         Special topics of civil engineering 1CP (L2378)       1       1         Special topics of civil engineering 2 LP (L2380)       3       3         Special topics of civil engineering 2 LP (L2380)       3       3         Structural Design (L2789)       2       2         Module Responsible       Prof. Frank Schmidt-Dôhl	Glass Structures (L1152)	Lecture	2	2	
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)       2       2         Module Responsible       Prof. Frank Schmidt-Dôhl       4         Admission Requirements       None       Recommended Previous       none         Recommended Previous       After taking part successfully, students have reached the following learning results       Professional Competence         Knowledge	Glass Structures (L1447)	Recitation Section (	large) 1	1	
Special topics of civil engineering 3 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       Image: Comparison of C	Testing and non-destructive examine	nation of concrete members (L2725) Project-/problem-ba	ised Learning 2	2	
Special topics of civil engineering 3 LP (L280)       3       3         Structural Design (L2789)       Seminar       2       2         Module Responsible       Prof. Frank Schmidt-Döhl       2       2         Admission Requirements       None       1       2       2         Recommeded Previous Knowledge       one       1       2       2         Educational Objectives       After taking part successfully, students have reached the following learning results       1       2       2         Professional Competence       Knowledge       •       5       5       5       1       3 <td< td=""><td>Special topics of civil engineering 1</td><td>CP (L2378)</td><td>1</td><td>1</td></td<>	Special topics of civil engineering 1	CP (L2378)	1	1	
Structural Design (L2789)       Seminar       2       2         Module Responsible       Prof. Frank Schmidt-Döhl         Admission Requirements       None         Recommended Previous Knowledge       none         Éducational 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.         Skills       - 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          Autonomy          • Students can chose independently, in which fields they want to deepen their knowledge and skills through the ele 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 Engineering: Elective Compulsory	Special topics of civil engineering 2	LP (L2379)	2	2	
Module Responsible         Prof. Frank Schmidt-Döhl           Admission Requirements         None           Recommended Previous         none           Knowledge         none           Educational Objectives         After taking part successfully, students have reached the following learning results           Professional Competence         Knowledge           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 apply basic methods in selected areas of civil and structural engineering.           • Students are able to apply basic methods in selected areas of civil and structural engineering.           • Students are able to apply basic methods in selected areas of civil and structural engineering.           • Students are able to apply basic methods in selected areas of civil and structural engineering.           • Students are able to apply basic methods in selected areas of civil and structural engineering.           • Students can chose independently, in which fields they want to deepen their knowledge and skills through the elecourses.           Workload in Hours         Depends on choice of courses           Credit points         6           Assignment for the Following Curricula         Civil Engineering: Specialisation Structural Engineering: Electiv	Special topics of civil engineering 3	LP (L2380)	3	3	
Admission Requirements       None         Recommended Previous       none         Knowledge       After taking part successfully, students have reached the following learning results         Professional Competence       Knowledge         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.         • Students are able to apply basic methods in selected areas of civil and structural engineering.         • Students are able to apply basic methods in selected areas of civil and structural engineering.         • Students are able to apply basic methods in selected areas of civil and structural engineering.         • Students are able to apply basic methods in selected areas of civil and structural engineering.         • Students can chose independently, in which fields they want to deepen their knowledge and skills through the elecurses.         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: Speciali	Structural Design (L2789)	Seminar	2	2	
Recommended Previous Knowledge       none         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.         • Students are able to apply basic methods in selected areas of civil and structural engineering.         • Students are able to apply basic methods in selected areas of civil and structural engineering.         • Students can chose independently, in which fields they want to deepen their knowledge and skills through the elecourses.         Workload in Hours       Depends on choice of courses         Credit points       6         Assignment for the Following Curricula       Civil Engineering: Specialisation Structural Engineering: Elective Compulsory         Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory	Module Responsible	Prof. Frank Schmidt-Döhl			
Knowledge         Educational Objectives       After taking part successfully, students have reached the following learning results         Professional Competence       Knowledge         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.         Skills       • 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       • Students are able to apply basic methods in selected areas of civil and structural engineering.         • Students are able to apply basic methods in selected areas of civil and structural engineering.         • Students are able to apply basic methods in selected areas of civil and structural engineering.         • Students are able to apply basic methods in selected areas of civil and structural engineering.         • Students can chose independently, in which fields they want to deepen their knowledge and skills through the elecourses.         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 Engineering: Elect	Admission Requirements	None			
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.         Skills       • 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 elecourses.         Workload in Hours       Depends on choice of courses         Credit points       6         Assignment for the Following Curricula       Civil Engineering: Specialisation Structural Engineering: Elective Compulsory	Recommended Previous	none			
Professional Competence       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 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.         • Students are able to apply basic methods in selected areas of civil and structural engineering.         • Students are able to apply basic methods in selected areas of civil and structural engineering.         • Students can chose independently, in which fields they want to deepen their knowledge and skills through the elecourses.         Workload in Hours       Depends on choice of courses         6       Credit points       6         Assignment for the Following Curricula       Civil Engineering: Specialisation Structural Engineering: Elective Compulsory	Knowledge				
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.         • Students are able to apply basic methods in selected areas of civil and structural engineering.         • Students are able to apply basic methods in selected areas of civil and structural engineering.         • Students are able to apply basic methods in selected areas of civil and structural engineering.         • Students are able to apply basic methods in selected areas of civil and structural engineering.         • Students are able to apply basic methods in selected areas of civil and structural engineering.         • Students are able to apply basic methods in selected areas of civil and structural engineering.         • Students can chose independently, in which fields they want to deepen their knowledge and skills through the elecourses.         • Workload in Hours       Depends on choice of courses         • Credit points       6         • Credit points       6         • Civil Engineering: Specialisation Structural Engineering: Elective Compulsory         • Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory	Educational Objectives	After taking part successfully, students have reached the following learning results			
<ul> <li>Students are able to find their way through selected special areas within civil and structural engineering.</li> <li>Students are able to explain basic models and procedures in selected special areas of civil and structural engineering.</li> <li>Students are able to interrelate scientific and technical knowledge.</li> <li>Students are able to apply basic methods in selected areas of civil and structural engineering.</li> <li>Students are able to apply basic methods in selected areas of civil and structural engineering.</li> <li>Students are able to apply basic methods in selected areas of civil and structural engineering.</li> <li>Students are able to apply basic methods in selected areas of civil and structural engineering.</li> <li>Students can chose independently, in which fields they want to deepen their knowledge and skills through the elector courses.</li> <li>Workload in Hours</li> <li>Depends on choice of courses</li> <li>Credit points</li> <li>Civil Engineering: Specialisation Structural Engineering: Elective Compulsory</li> <li>Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory</li> </ul>	Professional Competence				
Students are able to apply basic methods in selected areas of civil and structural engineering.     Social Competence     Autonomy     Students can chose independently, in which fields they want to deepen their knowledge and skills through the electors.     Social in Hours     Depends on choice of courses     Credit points     6     Assignment for the     Civil Engineering: Specialisation Structural Engineering: Elective Compulsory     Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory	Knowledge	• Students are able to explain basic models and procedures in selected special areas of civil and structural engineering.			
Social Competence          Autonomy          • Students can chose independently, in which fields they want to deepen their knowledge and skills through the electronic courses.         Workload in Hours       Depends on choice of courses         Credit points       6         Assignment for the Following Curricula       Civil Engineering: Specialisation Structural Engineering: Elective Compulsory         Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory		• Students are able to apply basic methods in selected areas of civil and structural engineering.			
Autonomy       • Students can chose independently, in which fields they want to deepen their knowledge and skills through the electronic courses.         Workload in Hours       Depends on choice of courses         Credit points       6         Assignment for the Following Curricula       Civil Engineering: Specialisation Structural Engineering: Elective Compulsory         Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory	Personal Competence				
Students can chose independently, in which fields they want to deepen their knowledge and skills through the ele courses.     Depends on choice of courses     Credit points     G     Assignment for the Following Curricula     Civil Engineering: Specialisation Structural Engineering: Elective Compulsory     Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory	Social Competence				
Credit points       6         Assignment for the       Civil Engineering: Specialisation Structural Engineering: Elective Compulsory         Following Curricula       Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory	Autonomy		ir knowledge and skills	through the election o	
Assignment for the       Civil Engineering: Specialisation Structural Engineering: Elective Compulsory         Following Curricula       Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory	Workload in Hours	Depends on choice of courses			
Following Curricula Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory	Credit points	6			
	Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			
	Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory			
Livii Engineering: Specialisation Coastal Engineering: Elective Compulsory	-	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory			
Civil Engineering: Specialisation Water and Traffic: Elective Compulsory					

Course L0653: Ergonomics	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and	30 min
scale	
Lecturer	Dr. Armin Bossemeyer
Language	DE
Cycle	WiSe
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	Sose Topic 1: Types of Offshore Structures, Fixed and floating structures for Oil & Gas and Offshore Wind industry
content	
	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 L2387: Excellence in International Project Delivery	
Тур	Integrated Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	laut FSPO
Examination duration and	wird zu Beginn der Lehrveranstaltung festgelegt
scale	
Lecturer	Dr. Jens Huckfeldt
Language	EN
Cycle	SoSe
Content	
Literature	

Course L0596: Design of Pre	fabricated Concrete Structures
Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Examination Form	Klausur
Examination duration and	60 min
scale	
Lecturer	Prof. Günter Rombach
Language	DE
Cycle	SoSe
Content	<ul> <li>application and advantages and disadvantages of precast concrete structures</li> <li>basics of design - precast element production - construction - tolerances</li> <li>elements of a warehouse</li> <li>design of a beam - joints</li> <li>design of D-regions: half joints, corbels, openings</li> <li>slab types - walls - facades</li> <li>footings: pocket and block foundations</li> <li>joints - connections</li> <li>shear design of the interface between concrete cast at different times</li> <li>unreinforced concrete structures</li> </ul>
Literature	<ul> <li>Bachmann H., Steinle A.; Hahn V.: Bauen mit Betonfertigteilen. Betonkalender 2009, Teil I, Verlag Ernst &amp; Sohn, Berlin</li> <li>Bindseil P.: Stahlbetonfertigteile. Werner Verlag, 1998</li> <li>FIP: FIP Handbuch für Planung und Entwerfen von Fertigteilbauten (siehe Zeitschrift: Beton- und Fertigteiltechnik ab 3/1996</li> <li>Bergmeister K.: Konstruieren von Fertigteilen. Betonkalender 2005 Teil 2, S. 163-240</li> <li>Reineck KH.: Modellierung der D-Bereiche von Fertigteilen. Betonkalender 2005 Teil 2, S. 241-296</li> <li>Graubner CA. et. al.: Bemessung von Fertigteilen nach DIN 1045-1. Betonkalender 2005 Teil 2, S. 297-374</li> </ul> Broschüren der Fachvereinigung Deutscher Betonfertigteilbau e.V. siehe: www.fdb-fertigteilbau.de <ul> <li>www.systembauweise.de</li> </ul>

Course L0597: Design of Pre	Course L0597: Design of Prefabricated Concrete Structures	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Examination Form	Klausur	
Examination duration and	Siehe korrespondierende Vorlesung	
scale		
Lecturer	Prof. Günter Rombach	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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 L2447: Geotechnical	Engineering Design
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and	45 Min.
scale	
Lecturer	Prof. Jürgen Grabe, Dr. Tim Pucker
Language	DE
Cycle	WiSe
Content	The focus of the course is on the design of geotechnical structures. Methods and fundamental approaches for the successful processing of geotechnical designs are taught. Theoretical approaches are backed up with examples from everyday work in industry. In parallel to the theoretical content, students are given a practical task for a geotechnical design at beginning of the course, which will be worked on in small teams. In addition to the application of the already acquired technical knowledge, topics like realisation, construction sequence planning, cost calculation, optimisation and evaluation criteria are also part of the course. The event will be finished with the presentation of the designs.
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   2666: Innovative Tir	Course L2666: Innovative Timber Construction	
	Lecture	
Hrs/wk		
CP		
	Independent Study Time 62, Study Time in Lecture 28	
	Schriftliche Ausarbeitung	
Examination duration and		
scale	45 Milluteli	
	Dr. Andreas Meisel	
Language		
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"	
	- 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 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 L2725: Testing and n	ourse L2725: Testing and non-destructive examination of concrete members	
Тур	Project-/problem-based Learning	
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	Prof. Günter Rombach, Dr. Lukas Henze	
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	laut FSPO	
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	laut FSPO	
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	laut FSPO	
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	
	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				
		-	11	67
Title	(10275)	<b>Typ</b> Lecture	Hrs/wk 3	СР
Numerical Methods in Geotechnics Advanced Foundation Engineering		Lecture	2	3 2
Advanced Foundation Engineering		Recitation Section (large)	1	1
Module Responsible				
Admission Requirements				
Recommended Previous				
Knowledge				
		nave reached the following learning results		
Professional Competence	<u> </u>			
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structur	ral Engineering: Compulsory		
-				
	Civil Engineering: Specialisation Coastal	Engineering: Compulsory		
	Civil Engineering: Specialisation Water a	nd Traffic: Elective Compulsory		
	International Management and Engineer	ing: Specialisation II. Civil Engineering: Elective Co	mulsory	

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:	
Literature	<ul> <li>numerical simulations</li> <li>numerical algorithms</li> <li>finite element method</li> <li>application of finite element method in geomechanics</li> <li>constitutive models for soils</li> <li>contact models for soil structure interaction</li> <li>selected applications</li> </ul>	
Literature	<ul> <li>Wriggers P. (2001): Nichtlineare Finite-Elemente-Methoden, Springer Verlag, Berlin</li> <li>Bathe Klaus-Jürgen (2002): Finite-Elemente-Methoden. Springer Verlag, Berlin</li> </ul>	

Course 10497: Advanced Eou	Indition Engineering		
ourse 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	<ul> <li>Vertical drains</li> <li>Piles</li> <li>Ground improvement (Deep Compaction, Soil mixing)</li> <li>Vibration driving</li> <li>Jet grouting</li> <li>Slurry wall</li> <li>Deep excavation</li> </ul>		
Literature	<ul> <li>EAK (2002): Empfehlungen für Küstenschutzbauwerke</li> <li>EAU (2004): Empfehlungen des Arbeitsausschusses Uferbauwerke</li> <li>EAB (1988): Empfehlungen des Arbeitskreises Baugruben</li> <li>Grundbau-Taschenbuch, Teil 1-3, (1997), Ernst &amp; Sohn Verlag</li> </ul>		

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	Typ Hrs/wk CP	
Module Responsible	Dozenten des SD B	
Admission Requirements	None	
Recommended Previous Knowledge	Subjects of the Water Management and Waste specialisation.	
5	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 scien and society. The students can develop solving strategies and approaches for fundamental and practical problems in the field of wat management and waste. They may apply theory based procedures and integrate safety-related, ecological, ethical, and econon view points of science and society. Scientific work techniques that are used can be described and critically reviewed.	
Skills	s The students are able to independently select methods or planning approaches for the project work and to justify their choice. They can explain how these methods or approaches relate to solutions in the field of work and how the context of application here 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 the 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		
Examination duration and scale	See FSPO	
Assignment for the Following Curricula	Civil Engineering: Specialisation Water and Traffic: Compulsory	

Courses				
Title		Тур	Hrs/wk	СР
Practical Course in Water and Was	5,	Practical Course	2	3
Practicle Course of Wastewater Tee	hnology II (L0607)	Practical Course	3	3
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
<b>Recommended Previous</b>	Basic knowledge in chemistry and physics (	knowledge acquired at school)		
Knowledge				
Educational Objectives	After taking part successfully, students hav	e reached the following learning results		
Professional Competence				
Knowledge	The students know basic analytical proced	ures for evaluating the quality of water and	wastewater. They ha	ave knowledge ab
	fundamental process engineering features	of important water and wastewater treatment	technologies.	
Skills	The students are able to understand and	to practically apply methodologies for waste	water analysis as w	ell as descriptions
	experiments and experimental setups in wa	stewater technology.		
Personal Competence				
Social Competence				
Autonomy	The students are able to conduct experiments following written procedures without external assistance.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	ca. 5 Stunden			
scale				
Assignment for the	Civil Engineering: Specialisation Water and	Traffic: Elective Compulsory		
Following Curricula	Water and Environmental Engineering: Spe	ialisation Water: Elective Compulsory		
	Water and Environmental Engineering: Spe	cialisation Environment: Elective Compulsory		

Course L0503: Practical Course in Water and Wastewater Technology I		
Тур	Practical Course	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Dorothea Rechtenbach	
Language	EN	
Cycle	WiSe	
Content	- Impact of pretreatment of wastewater samples on analytical results	
	- Analysis of nutrients in wastewater samples (different methods for nitrate analysis)	
	- Alkalinity	
	- TOC, COD	
	- microscopic analysis of microorganisms relevant in wastewater treatment	
Literature	Skript auf StudIP	

Course L0607: Practicle Course of Wastewater Technology II		
Тур	Practical Course	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Dr. Joachim Behrendt	
Language	DE/EN	
Cycle	WiSe	
Content	Experiments:	
	Oxygen transfer	
	Oxygen Uptake rate	
	Sludge dewatering	
	Tracer	
	Flocculation	
Literature	Skript/Script	

Courses				
Courses				
Title	Anno noment (1.0226)	Тур	Hrs/wk 3	СР
Water Protection and Wastewater I Water Protection and Wastewater I	-	Lecture Project Seminar	3	3 3
Module Responsible	-		-	_
Admission Requirements				
Recommended Previous				
Knowledge	<ul> <li>Basic knowledge in water manageme</li> </ul>	ent;		
J.	<ul> <li>Good knowledge in urban drainage;</li> </ul>			
	Good knowledge of wastewater treat			
	<ul> <li>Good knowledge of pollutants (e.g. C</li> </ul>	COD, BOD, TS, N, P) and their properties;		
Educational Objectives	After taking part successfully, students hav	e reached the following learning results		
Professional Competence				
Knowledge	The students can describe the basic princip	les of the regulatory framework related to th	ne international and Eu	ıropean water sect
	They can explain limnological processes,	substance cycles and water morphology ir	n detail. They are able	e to assess comp
	problems related to water protection, such	h as ecosystem service and wastewater tre	eatment with a special	focus on innovat
	solutions, remediation measures as well as	conceptual approaches.		
Skills	Students can accurately assess current pro	oblems and situations in a country-specific o	or local context. They o	an suggest concr
		comorrow's urban water cycle. Furthermore		
	administrative and legislative solutions to s	olve these problems.		
Personal Competence	<b>-</b>			
Social Competence	The students can work together in internati	onai groups.		
Autonomy	Students are able to organize their work fl	ow to prepare presentations and discussion	s. They can acquire ap	propriate knowled
	by making enquiries independently.			
	Independent Study Time 96, Study Time in	Lecture 84		
Credit points				
Course achievement				
Examination				
scale	Term paper plus presentation			
Scale				
Assignment for the	Civil Engineering: Specialisation Structural	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnic	cal Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal En	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and	Traffic: Elective Compulsory		
	Environmental Engineering: Specialisation	Water: Elective Compulsory		
		: Specialisation II. Civil Engineering: Elective		
		dies - Cities and Sustainability: Specialisation	n Water: Elective Comp	oulsory
	Water and Environmental Engineering: Spe			
	Water and Environmental Engineering: Spe			
	Water and Environmental Engineering: Spe	cialisation 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	<ul> <li>The lecture focusses on:</li> <li>Regulatory Framework (e.g. WFD)</li> <li>Main instruments for the water management and protection</li> <li>In depth knowledge of relevant measures of water pollution control</li> <li>Urban drainage, treatment options in different regions on the world</li> <li>Rainwater management, improved management of heavy rainfalls, downpours, rainwater harvesting, rainwater infiltration</li> </ul>
	Case Studies and Field Trips
Literature	<ul> <li>The literature listed below is available in the library of the TUHH.</li> <li>Water and wastewater technology Hammer, M. J. 1., &amp; . (2012). (7. ed., internat. ed.). Boston [u.a.]: Pearson Education International.</li> <li>Water and wastewater engineering : design principles and practice: Davis, M. L. 1. (2011) New York, NY: McGraw-Hill.</li> <li>Biological wastewater treatment: (2011). C. P. Leslie Grady, Jr. (3. ed.). London, Boca Raton, Fla. [u.a.]: IWA Publ.</li> </ul>

Course L2008: Water Protect	tion 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	

Module M0802: Meml	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)	Duck Mathics Franch	Practical Course	1	1
Module Responsible Admission Requirements	Prof. Mathias Ernst None			
Recommended Previous		of the core processes involved in water, gas	and steam treat	ment
Knowledge	Basic knowledge of water chemistry. Knowledge	of the core processes involved in water, gas	and steam treat	nent
Educational Objectives	After taking part successfully, students have read	ched the following learning results		
Professional Competence	Arter taking part successionly, students have read	the the following learning results		
	Students will be able to rank the technical applic	sations of industrially important membrane r	rocossos Thoy y	uill be able to evol:
Knowledge	the different driving forces behind existing me			
	membrane filtration and their advantages and c			
	membranes in water, other liquid media, gases a	•	tain the key and	arenees in the use
	· · · · · · · · · · · · · · · · · · ·			
Skills	Students will be able to prepare mathematical e	equations for material transport in porous a	nd solution-diffu	sion membranes a
	calculate key parameters in the membrane sepa			
	available boundary data and provide recomment	ndations for the sequence of different trea	tment processes	. Through their o
	experiments, students will be able to classify			
	membrane materials. Students will be able to cha	aracterise the formation of the fouling layer i	n different water	s and apply techni
	measures to control this.			
Personal Competence				
	Students will be able to work in diverse teams o	n tasks in the field of membrane technology	. They will be ab	le to make decisio
,	within their group on laboratory experiments to b			
Autonomy	Students will be in a position to solve homewor	rk on the topic of membrane technology in	dependently. The	ey will be capable
	finding creative solutions to technical questions.			
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	<u> </u>			
Assignment for the	Civil Engineering: Specialisation Water and Traffic	c: Elective Compulsory		
Following Curricula	Bioprocess Engineering: Specialisation A - Genera	al Bioprocess Engineering: Elective Compulse	ory	
	Bioprocess Engineering: Specialisation B - Industr	rial Bioprocess Engineering: Elective Compul	sory	
	Chemical and Bioprocess Engineering: Specialisa	tion Chemical Process Engineering: Elective	Compulsory	
	Chemical and Bioprocess Engineering: Specialisa	• •		
	Energy and Environmental Engineering: Specialis		g: Elective Compu	ulsory
	Environmental Engineering: Specialisation Water	1 3		
	Joint European Master in Environmental Studies -		er: Elective Com	oulsory
	Process Engineering: Specialisation Process Engin			
	Process Engineering: Specialisation Environmenta			
	Water and Environmental Engineering: Specialisa	1 3		
	Water and Environmental Engineering: Specialisa			
	Water and Environmental Engineering: Specialisa	ation Cities: Elective Compulsory		

Course L0399: Membrane Te	chnology
Тур	Lecture
Hrs/wk	2
CP	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	<ul> <li>T. Melin, R. Rautenbach: Membranverfahren: Grundlagen der Modul- und Anlagenauslegung (2., erweiterte Auflage), Springer-Verlag, Berlin 2004.</li> <li>Marcel Mulder, Basic Principles of Membrane Technology, Kluwer Academic Publishers, Dordrecht, The Netherlands</li> <li>Richard W. Baker, Membrane Technology and Applications, Second Edition, John Wiley &amp; Sons, Ltd., 2004</li> </ul>

Course L0400: Membrane Te	ourse 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	chnology
Тур	Practical Course
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Mathias Ernst
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Courses				
Title		Тур	Hrs/wk	СР
Scientific Working in Computationa	5 5	Project-/problem-based Learning	4	6
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
<b>Recommended Previous</b>	Basic knowledge in scientific writing. String interest in topics related to computing in civil engineering.			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
	thinking, being able to accurately plan, implement and analyze scientific projects, such as prospective master theses. S scientific writing is of particular importance in this course, a scientific paper will be developed, which is a prerequisite for the examination. The paper will be written based on a project to be conducted within this course. Project meetings in small gro presentations, and critical discussions of scientific publications are further key activities.		requisite for the fir	
Skills				
Personal Competence Social Competence				
Autonomy				
,	Independent Study Time 124, Study Tim	ie in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	10 pages of work with 15-minute oral pro	esentation		
scale				
Assignment for the	Civil Engineering: Specialisation Water a	nd Traffic: Elective Compulsory		
	Civil Engineering: Specialisation Geotech	nnical Engineering: Elective Compulsory		
Following Curricula	civil Engineering. Specialisation Geoteci	inical Engineering. Elective compulsory		
Following Curricula	Civil Engineering: Specialisation Coostal Civil Engineering: Specialisation Coastal	Engineering: Elective Compulsory		

Course L2764: Scientific Wor	rking in Computational Engineering
Тур	Project-/problem-based Learning
Hrs/wk	4
CP	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	

Courses	
<b>Title</b> Adaptation to climate change in hy	rdraulic engineering (L2291) Typ Hrs/wk CP 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	<ul> <li>Climate protection and climate adaptation</li> <li>Insights into climate change and its regional characteristics - fundamentals, climate modelling / climate models</li> <li>Impacts of climate change on the components of the regional hydrological cycle</li> <li>Fundamentals of analysis of climate data</li> <li>Consequences of the impact of the climate change</li> <li>Measures for climate adaptation</li> <li>Assessment, prioritization and communication of adaptation measures</li> <li>Fundamentals of the analysis of hydrometeorological and hydrological data</li> </ul>
Personal Competence Social Competence Autonomy	<ul> <li>Working in heterogenous groups</li> <li>Working with different scientific / non-scientific disciplines</li> <li>Self reflection</li> </ul>
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	
Course achievement	None
Examination	Written elaboration
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 Vater 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	climate change in hydraulic engineering
	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	<ul> <li>Climate protection and climate adaptation</li> <li>Findings on climate change and its regional characteristics: fundamentals of climate change, climate modelling / climate models</li> <li>Impacts of climate change on the components of the regional hydrological cycle(climate science view)</li> <li>Fundamentals of the analysis of climate data</li> <li>Concequences of the impacts of climate change (ingenieering science view)</li> <li>Measures for climate change adaptation</li> <li>Assessment, prioritization and communication of measures</li> <li>Fundamentals of analysis of hydrometeorological and hydrological data</li> </ul>
Literature	Bereitgestellte eLearning Plattform

	Thesis
Module M-002: Maste	
module m-002. Maste	1 11(5)5
Courses	
Γitle	Typ Hrs/wk CP
Module Responsible	Professoren der TUHH
Admission Requirements	According to General Regulations §21 (1):
	At least 60 credit points have to be achieved in study programme. The examinations board decides on exceptions.
Recommended Previous	
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
<b>Professional Competence</b>	
Knowledge	The students can use specialized knowledge (facts, theories, and methods) of their subject competently on specialized
	issues.
	• The students can explain in depth the relevant approaches and terminologies in one or more areas of their subje
	describing current developments and taking up a critical position on them.
	• The students can place a research task in their subject area in its context and describe and critically assess the state
	research.
Skills	The students are able:
	• To select, apply and, if necessary, develop further methods that are suitable for solving the specialized problem in question
	• To apply knowledge they have acquired and methods they have learnt in the course of their studies to complex and
	incompletely defined problems in a solution-oriented way.
	<ul> <li>To develop new scientific findings in their subject area and subject them to a critical assessment.</li> </ul>
Personal Competence	
Social Competence	
	Both in writing and orally outline a scientific issue for an expert audience accurately, understandably and in a structur
	<ul> <li>way.</li> <li>Deal with issues competently in an expert discussion and answer them in a manner that is appropriate to the addresse</li> </ul>
	while upholding their own assessments and viewpoints convincingly.
Autonomy	Students are able:
	• To structure a project of their own in work packages and to work them off accordingly.
	<ul> <li>To structure a project of their own in work packages and to work them off accordingly.</li> <li>To work their way in depth into a largely unknown subject and to access the information required for them to do so.</li> </ul>
	<ul> <li>To apply the techniques of scientific work comprehensively in research of their own.</li> </ul>
Workload in Hours	Independent Study Time 900, Study Time in Lecture 0
Credit points	
Course achievement	None
Examination	Thesis
Examination duration and	According to General Regulations
scale	
Assignment for the	Civil Engineering: Thesis: Compulsory
Following Curricula	
	Chemical and Bioprocess Engineering: Thesis: Compulsory
	Computer Science: Thesis: Compulsory Electrical Engineering: Thesis: Compulsory
	Energy and Environmental Engineering: Thesis: Compulsory
	Energy Systems: Thesis: Compulsory
	Environmental Engineering: Thesis: Compulsory
	Environmental Engineering: Thesis: Compulsory
	Environmental Engineering: Thesis: Compulsory Aircraft Systems Engineering: Thesis: Compulsory
	Environmental Engineering: Thesis: Compulsory Aircraft Systems Engineering: Thesis: Compulsory Global Innovation Management: Thesis: Compulsory
	Environmental Engineering: Thesis: Compulsory Aircraft Systems Engineering: Thesis: Compulsory Global Innovation Management: Thesis: Compulsory Computational Science and Engineering: Thesis: Compulsory Information and Communication Systems: Thesis: Compulsory Interdisciplinary Mathematics: Thesis: Compulsory
	Environmental Engineering: Thesis: Compulsory Aircraft Systems Engineering: Thesis: Compulsory Global Innovation Management: Thesis: Compulsory Computational Science and Engineering: Thesis: Compulsory Information and Communication Systems: Thesis: Compulsory Interdisciplinary Mathematics: Thesis: Compulsory International Management and Engineering: Thesis: Compulsory
	Environmental Engineering: Thesis: Compulsory Aircraft Systems Engineering: Thesis: Compulsory Global Innovation Management: Thesis: Compulsory Computational Science and Engineering: Thesis: Compulsory Information and Communication Systems: Thesis: Compulsory Interdisciplinary Mathematics: Thesis: Compulsory International Management and Engineering: Thesis: Compulsory Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory
	Environmental Engineering: Thesis: Compulsory Aircraft Systems Engineering: Thesis: Compulsory Global Innovation Management: Thesis: Compulsory Computational Science and Engineering: Thesis: Compulsory Information and Communication Systems: Thesis: Compulsory Interdisciplinary Mathematics: Thesis: Compulsory International Management and Engineering: Thesis: Compulsory Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory Logistics, Infrastructure and Mobility: Thesis: Compulsory
	Environmental Engineering: Thesis: Compulsory Aircraft Systems Engineering: Thesis: Compulsory Global Innovation Management: Thesis: Compulsory Computational Science and Engineering: Thesis: Compulsory Information and Communication Systems: Thesis: Compulsory Interdisciplinary Mathematics: Thesis: Compulsory International Management and Engineering: Thesis: Compulsory Joint European Master in Environmental Studies - Cities and Sustainability: 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
Ship and Offshore Technology: Thesis: Compulsory
Teilstudiengang Lehramt Metalltechnik: Thesis: Compulsory
Theoretical Mechanical Engineering: Thesis: Compulsory
Process Engineering: Thesis: Compulsory
Water and Environmental Engineering: Thesis: Compulsory
Certification in Engineering & Advisory in Aviation: Thesis: Compulsory