## **Module Manual**

Master of Science (M.Sc.)

# **Civil Engineering**

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Module	zation M0964: M0595: M0923: M0801: M0830: M0902: M0826: M1403: M0874: M0873: M0703: M1351: M0871: M0875: M0922: M09977: M0998: M0593: M	Water and Traffic Underground Constructions Examination of Materials, Structural Condition and Damages Integrated Transportation Planning Water Resources and -Supply Environmental Protection and Management Wastewater Treatment and Air Pollution Abatement Biology, Geology and Chemistry Construction and Simulation of Sewerage Systems Wastewater Systems Urban Environmental Management Soil and Groundwater Contamination Construction Processes Hydrological Systems Nexus Engineering - Water, Soil, Food and Energy City Planning Construction Logistics and Project Management Statics and Dynamics of Structures Building Materials and Building Preservation Transportation Modelling Waste Treatment and Solid Matter Process Technology Modeling in Water Management	320 322 324 326 328 331 334 337 340 343 347 349 351 353 356 359 361 364 368 371 373 376 378
Module	zation M0964: M0595: M0923: M0801: M0830: M0902: M0826: M1403: M0874: M0874: M0875: M0977: M0998: M0593: M0593: M0593: M0749: M0827: M0870: M0870: M0860:	Water and Traffic Underground Constructions Examination of Materials, Structural Condition and Damages Integrated Transportation Planning Water Resources and -Supply Environmental Protection and Management Wastewater Treatment and Air Pollution Abatement Biology, Geology and Chemistry Construction and Simulation of Sewerage Systems Wastewater Systems Urban Environmental Management Soil and Groundwater Contamination Construction Processes Hydrological Systems Nexus Engineering - Water, Soil, Food and Energy City Planning Construction Logistics and Project Management Statics and Dynamics of Structures Building Materials and Building Preservation Transportation Modelling Waste Treatment and Solid Matter Process Technology Modeling in Water Management Management of Surface Water Harbour Engineering and Harbour Planning	320 322 324 326 328 331 334 337 340 343 347 349 351 353 356 359 361 364 368 371 373 376 378
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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 so 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 "Nontechnical 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**

Module M0523	3: Business & Management		
Module Responsible	Prof. Matthias Meyer		
Admission Requirements	one		
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> </ul>		
Personal Competence			
Social Competence	<ul> <li>Students are able to communicate in small interdisciplinary groups and to jointly develop solutions for complex problems</li> </ul>		
Autonomy	<ul> <li>Students are capable of acquiring necessary knowledge independently by means of research and preparation of material.</li> </ul>		
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 M0524: Non-technical Courses for Master		
Admission Requirements	None	
Recommended Previous Knowledge	None	
Educational Objectives	After taking part successfully, students have reached the following learning results	
Professional Competence		

### 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 fully. Self-reliance, self-management, collaboration and professional and personnel management competences. The department implements these training objectives in its teaching architecture, in its teaching and learning arrangements, in teaching areas and by means of teaching offerings in which students can qualify by opting for specific competences and a competence level at the Bachelor's or Master's level. The teaching offerings are pooled in two different catalogues for nontechnical complementary courses.

### The Learning Architecture

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

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

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

### **Teaching and Learning Arrangements**

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

# Knowledge Fields of Teaching

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

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

### **The Competence Level**

of the courses offered in this area is different as regards the basic training objective

in the Bachelor's and Master's fields. These differences are reflected in the practical examples used, in content topics that refer to different professional application contexts, and in the higher scientific and theoretical level of abstraction in the B.Sc.

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

### **Specialized Competence (Knowledge)**

Students can

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

### **Professional Competence (Skills)**

In selected sub-areas students can

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

# Personal Competence

Skills

### **Personal Competences (Social Skills)**

Students will be able

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

### Social Competence

### **Personal Competences (Self-reliance)**

Students are able in selected areas

• to reflect on their own profession and professionalism in the context of reallife fields of application

Autonomy	<ul> <li>to organize themselves and their own learning processes</li> <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> <li>to organize themselves as an entrepreneurial subject country (as far as this study-focus would be chosen)</li> </ul>
<b>Workload in Hours</b>	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 M0808	3: Finite Elements	s Methods			
Courses					
<b>Title</b> Finite Element Method Finite Element Method			<b>Typ</b> Lecture Recitation (large)	Hrs/wk 2 Section 2	<b>CP</b> 3
Module Responsible	Prof. Otto von Estorff		(large)		
Admission Requirements	None				
Recommended Previous Knowledge	Kinematics, Dynamics)				Hydrostatics
Educational Objectives	After taking part success	fully, students ha	ave reached th	ne following lear	ning results
Professional Competence		in double lessen.	- d		
Knowledge	The students possess ar element method and are basis of the method.				
Skills	The students are capabl finite elements, assemb resulting system of equa	ling the corresp			
Personal Competence					
Social Competence	Students can work in sm	all groups on spe	cific problems	s to arrive at join	t solutions.
Autonomy	The students are able to and develop own finite e are critically scrutinized.				
Workload in Hours	Independent Study Time	124, Study Time	in Lecture 56	;	
Credit points	6				
achievement	No 20 % I	F <b>orm</b> Midterm	De	escription	
Examination					
Examination duration and scale					
	Civil Engineering: Core q Energy Systems: Core qu Aircraft Systems Enginee Aircraft Systems Engine	ıalification: Electi ering: Specialisati	ve Compulsor on Aircraft Sy	stems: Elective (	

Assignment for the Following Curricula	Compulsory International Management and Engineering: Specialisation II. Mechatronics: Elective Compulsory International Management and Engineering: Specialisation II. Product Development and Production: Elective Compulsory Mechatronics: Core qualification: Compulsory Biomedical Engineering: Specialisation Implants and Endoprostheses: Compulsory Biomedical Engineering: Specialisation Management and Business Administration: Elective Compulsory Biomedical Engineering: Specialisation Medical Technology and Control Theory: Elective Compulsory Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medicine: Elective Compulsory Product Development, Materials and Production: Core qualification: Compulsory Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Theoretical Mechanical Engineering: Core qualification: Compulsory
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Course L0291: Finite Element Methods		
Тур	Lecture	
Hrs/wk 2		
СР	3	
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Otto von Estorff	
Language	EN	
Cycle	WiSe	
Content	<ul> <li>General overview on modern engineering</li> <li>Displacement method</li> <li>Hybrid formulation</li> <li>Isoparametric elements</li> <li>Numerical integration</li> <li>Solving systems of equations (statics, dynamics)</li> <li>Eigenvalue problems</li> <li>Non-linear systems</li> <li>Applications</li> <li>Programming of elements (Matlab, hands-on sessions)</li> <li>Applications</li> </ul>	
Literature	Bathe, KJ. (2000): Finite-Elemente-Methoden. Springer Verlag, Berlin	

Course L0804: Finite Element Methods		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	3	
<b>Workload in Hours</b>	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	

Module M0962	2: Sustainability and Ris	k Managemen	t	
Courses				
<b>Title</b> Safety, Reliability and Environment and Sust	Risk Assessment (L1145) ainability (L0319)	<b>Typ</b> Seminar Lecture	<b>Hrs/wk</b> 2 2	<b>CP</b> 3 3
- Mespensiale				
Admission Requirements	None			
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, stud	After taking part successfully, students have reached the following learning results		
Professional Competence				
Knowledge	Students are able to describe singl of safety and risk assessment engineering, in detail:  • basics in safety and reliabilit engineering and reliability analysi enisk assessment engument energy production and suppe sustainable product design	as well as envir y of technical facilities methods	onmental and	
Skills	Students are able apply intercassessment and sustainability reprocesses and select economically	orting. They can evalu	uate the effort a	ds for risl and costs fo
Personal Competence				
Social Competence				
Autonomy	Students can gain knowledge of the it to new questions. Furthermore, research-oriented duties in concepts accordance with the pote	they can define target for risk manage	gets for new apment and s	oplication o sustainability
Workload in Hours	Independent Study Time 124, Stud	y Time in Lecture 56		
Credit points				
Course achievement	None			
Examination	Written elaboration			
Examination duration and scale	Elaboration and presentation (45 m	ninutes in groups)		
the Following	Civil Engineering: Core qualification Bioprocess Engineering: Specialisa Management and Controlling: Elect International Management and E Elective Compulsory Product Development, Materia Development: Elective Compulsory Product Development, Materials and	tion C - Bioeconomic live Compulsory ngineering: Specialis Is and Production	sation II. Civil n: Specialisation	Engineering on Produc

Compulsory
Product Development, Materials and Production: Specialisation Materials: Elective
Compulsory
Water and Environmental Engineering: Core qualification: Compulsory

Course L1145: Safe	ety, Reliability and Risk Assessment
Тур	Seminar
Hrs/wk	2
СР	3
<b>Workload in Hours</b>	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	<ul> <li>Vorlesungsunterlagen</li> <li>Schneider, J., Schlatter, H.P.: Sicherheit und Zuverlässigkeit im Bauwesen. www.risksafety.ch/files/sicherheit_und_zuverlaessigkeit.pdf</li> </ul>

Course L0319: Envi	ironment and Sustainability
Тур	Lecture
Hrs/wk	2
СР	3
<b>Workload in Hours</b>	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.
Literature	Wird in der Veranstaltung bekannt gegeben.

# **Specialization Coastal Engineering**

Module M0699	9: Geotechnics III	l			
Courses					
<b>Title</b> Numerical Methods in Geotechnics (L0375) Advanced Foundation Engineering (L0497) Advanced Foundation Engineering (L0498)			Typ Lecture Lecture Recitation (large)	Hrs/wk 3 2 Section 1	<b>CP</b> 3 2
Module Responsible	Prof. Jürgen Grabe				
Admission Requirements	None				
Recommended Previous Knowledge					
Educational Objectives		sfully, students	have reached	the following learr	ing results
Professional Competence					
Knowledge Skills					
Personal Competence Social Competence Autonomy					
-	Independent Study Time	e 96, Study Time	e in Lecture 84	ļ	
Credit points	6				
Course achievement	Yes None	<b>Form</b> Subject theor practical work	retical and	Description	
Examination	Written exam				
Examination duration and scale	120 min				
Assignment for the Following Curricula	Civil Engineering: Specia	alisation Geotech alisation Coastal alisation Water a	hnical Enginee Engineering: and Traffic: Ele	ering: Compulsory Compulsory ective Compulsory	Engineering:

Course L0375: Nun	nerical Methods in Geotechnics
Тур	Lecture
Hrs/wk	3
СР	3
<b>Workload in Hours</b>	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: Adv	anced Foundation Engineering
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Jürgen Grabe	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0858	3: Coastal Hydraulic Er	ginee	ring I		
Courses					
<b>Title</b> Basics of Coastal Engir	neering (L0807)		<b>Typ</b> Lecture	Hrs/wk 3	<b>CP</b> 4
Basics of Coastal Engir	neering (L1413)		Project-/problem- based Learning	1	2
Module Responsible	Prof. Peter Fröhle				
Admission Requirements	None				
Recommended Previous Knowledge	Basics of hydraulic engineering,	hydrolog	y and hydromechar	nics	
Educational Objectives	After taking part successfully, st	udents h	ave reached the foll	lowing learn	ing results
Professional Competence					
Knowledge	The students are able to define and explain the basic concepts of coastal engineering and port engineering. They are able to apply the concepts to selected practical problems of coastal engineering. Students can define and determine the basics for design and dimensioning of coastal engineering constructions.				
Skills	The students are capable to apply basic design approaches to selected and predefined design tasks in coastal engineering.				
Personal Competence					
Social Competence	The students are able to deploy their gained knowledge in applied problems such as the design of coastal protection structures. 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 ind new problems.	epender	itly extend their kn	owledge ar	d applyit to
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Course achievement	INODE				
Examination	Written exam				
Examination duration and scale	respect to the general understanding of the lecture contents and calculations tasks.				
the Following	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Compulsory Civil Engineering: Specialisation Coastal Engineering: Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory				

Course L0807: Basics of Coastal Engineering		
Тур	Lecture	
Hrs/wk	3	
СР	4	
<b>Workload in Hours</b>	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Peter Fröhle	
<b>L</b> anguage	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                 <ul> <li>Filter</li> <li>Rubble mound constructions</li> <li>Piles</li> <li>Vertical constructions</li> </ul> </li> </ul> </li> </ul>	
Literature	Coastal Engineering Manual, CEM Vorlesungsumdruck	

Course L1413: Basics of Coastal Engineering	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	2
<b>Workload in Hours</b>	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	1: Underground Construct	ions		
Courses				
Title Applied Tunnel Construintroduction to tunnel	construction (L0707)	<b>Typ</b> Lecture Lecture Recitation (large)	Hrs/wk 2 1 Section 1	<b>CP</b> 3 2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous Knowledge	00010011111001111	nd environmenta	l engineering:	
Educational Objectives	After taking part successfully, student	s have reached	the following learn	ing results
Professional Competence				
Knowledge	Knowledge 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 quay walls. Futhermore, the students get all the neccessary knowledge to design singular construction elements for sheet pile walls and they know how to choose the right construction elements depending on the influencing conditions.			
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 sheet the suitable construction.			
Personal Competence				
	Capacity for teamwork concerning pro	oject manageme	nt and design of tu	ınnels.
Autonomy	Promotion of independent and creat exercise.	-	_	
<b>Workload in Hours</b>	Independent Study Time 124, Study T	ime in Lecture 5	6	
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following Curricula	Civil Engineering: Specialisation Struc Civil Engineering: Specialisation Geote Civil Engineering: Specialisation Coast Civil Engineering: Specialisation Wate International Management and Eng Elective Compulsory	echnical Enginee tal Engineering: ( r and Traffic: Ele	ring: Compulsory Compulsory ctive Compulsory	-

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

Course L0707: Intro	oduction to tunnel construction
Тур	Lecture
Hrs/wk	1
СР	2
<b>Workload in Hours</b>	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
СР	1
<b>Workload in Hours</b>	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	L: Electricity Generation	on from Wind an	d Hydro Po	wer
Courses				
<b>Title</b> Sustainability Manager Hydro Power Use (L002) Wind Turbine Plants (L Wind Energy Use - Foc	13) 0011)	<b>Typ</b> Lecture Lecture Lecture Lecture Lecture	Hrs/wk 2 1 2 1	CP 1 1 3 1
Module Responsible	Dr. Isabel Höfer			
Admission Requirements	None			
Recommended Previous Knowledge		mics II,		
Educational Objectives	After taking part successfully, st	udents have reached th	e following learn	ing results
Professional Competence		s can evolain in detail	knowledge of w	ind turbines
Knowledge	By ending this module students can explain in detail knowledge of wind turbines with a particular focus of wind energy use in offshore conditions and can critical comment these aspects in consideration of current developments. Furthermore, they are able to describe fundamentally the use of water power to generate electricity. The students reproduce and explain the basic procedure 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 the application of the theoretical background and are thus able to transfer what they have learned in practice.			
Skills	Students are able to apply the acquired theoretical foundations on exemplary water or wind power systems and evaluate and assess technically the resulting relationships in the context of dimensioning and operation of these energy systems. They can in 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 sources in the context of the emphasis of the lecture material to clear the contents of the lecture and to acquire the particular knowledge about the subject area.			
Workload in Hours	Independent Study Time 96, Stu	idy Time in Lecture 84		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale	2.5 hours written exam + Prens	entation in sustainability	/ management	

Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Energy and Environmental Engineering: Specialisation Energy Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Renewable Energy: **Elective Compulsory** International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory Product Development, Materials and Production: Specialisation Product Assignment for Development: Elective Compulsory the Following Product Development, Materials and Production: Specialisation Production: Elective Curricula Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Renewable Energies: Core qualification: Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Compulsory Water and Environmental Engineering: Specialisation Cities: Elective Compulsory

Course L0007: Sustainability Management		
Тур	Lecture	
Hrs/wk	2	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dr. Anne Rödl	
Language	DE	
Cycle	WiSe	
Content	The lecture sustainability management provide an insight into the various aspects and dimensions of sustainability. This content of the course is based on the foundations of environmental assessment; therefore the previous attendance of the lecture environmental assessment is recommended. Various valuation approaches for assessing environmental, economic and social aspects are presented. Their application and use for a sustainability management's discussion is explained by means of short technology examples and is later comprehensively presented through case examples.  • Introduction to the topic of sustainability • Dimensions of sustainability:  • ecology  • economics  • social  • Transition from the environmental assessment for sustainability management  • Case Studies  • Excursion  Objective: The aim of the course is to learn methods for the assessment of sustainability aspects and apply for sustainability management.	
Literature	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	
<b>Workload in Hours</b>	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	
<b>Workload in Hours</b>	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: Win	d Energy Use - Focus Offshore
Тур	Lecture
Hrs/wk	1
СР	1
<b>Workload in Hours</b>	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, Heidelberg, 1997, 3. Auflage</li> <li>Hau, E.: Windkraftanalagen; 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>

Module M1351	L: Construction Pro	cesses		
Courses				
Title		Тур	Hrs/wk	СР
Digital Building (L1908	3)	Lecture	2	2
Lean Construction (L19	•	Lecture	2	2
System Dynamics (L19	909)	Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successful	ly, students have reached the	following learn	ing results
Professional				
Competence				
Knowledge				
Skills				
Personal				
Competence				
Social Competence				
Autonomy				
<b>Workload in Hours</b>	Independent Study Time 96	, Study Time in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following Curricula	Civil Engineering: Specialisa Civil Engineering: Specialisa	ation Coastal Engineering: Elec ation Geotechnical Engineering ation Structural Engineering: El ation Water and Traffic: Electiv	: Elective Com lective Compul	pulsory

Course L1908: Digital Building	
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Theo Herzog
Language	DE
Cycle	SoSe
Content	
Literature	

Course L1909: Syst	Course L1909: System Dynamics	
Тур	Lecture	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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 Repair of Structures (L' Mineral Building Materi		Typ Lecture Lecture	Hrs/wk 1 2	<b>CP</b> 1 2
_	Building Materials (L0256)	Project-/problem-	1	2
	Building Materials and Damage Processes	based Learning Lecture	1	1
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge about building materials, building physics and building chemistry, for example by the modules Principles of Building Materials and Building Physics and Building Materials and Building Chemistry.			
Educational Objectives	After taking part successfully, students h	nave reached the foll	owing learn	ing results
Professional Competence				
Knowledge	The students are able to describe the components of mineral building materials and their function in detail and to use them for the manufacture of special mineral building materials. They are able to show the characteristics of mineral building materials. They are able to describe the manufacture, properties and fields of application of special mortars and special concretes and the correlations of their material parameters. They are able to show the principles of anchor technology and design.			
Skills	The students are able to perform an optimization of granulometry of a mineral building material. They are able to design a special mineral mortar and to manufacture this mortar. The students are able to manufacture post installed rebar connections. They are able to recognize damages, to assess possible causes, to use the fundamentals of construction preservation and to select repair and strengthening measures.			
Personal Competence Social Competence				
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.			
	Independent Study Time 110, Study Tim	e in Lecture 70		
Credit points				
Course achievement	Yes 20 % Form Subject theorem	<b>Descrip</b> etical and	otion	
Examination	·			
Examination duration and scale				

Assignment for the Following Curricula

Civil Engineering: Specialisation Geotechnical Engineering: Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory

Course L0255: Repair of Structures		
Тур	Lecture	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Frank Schmidt-Döhl	
Language	DE	
Cycle		
	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	
<b>Workload in Hours</b>	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	
<b>Workload in Hours</b>	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	
	Taylor, H.F.W.: Cement Chemistry	
Literature	Springenschmid, R.: Betontechnologie für die Praxis	

Course L0254: Transport Processes in Building Materials and Damage Processes		
Тур	Lecture	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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	

Module M072 Bridges	23: Design of Prestressed Structures and Concrete			
Courses				
	Typ Hrs/wk CP Structures and Concreet Bridges (L0603) Lecture 3 4 Structures and Concreet Bridges (L0604) Recitation (large) 2 2			
Module Responsible	i Prof. Gunter Rompach			
Admission Requirements	None			
	Detailed knowledge on the design of concrete structures.  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 types, their applications and the various loads. They can explain the basic design methods. They can explain the design of a prestressed bridge.			
Skills	The students are able to design reinforced or prestressed concrete bridges.			
Personal Competence				
Social 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.			
-	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Course achievement	None			
	Written exam			
Examination duration and scale	180 minutes			
the Following	Civil Engineering: Specialisation Structural Engineering: Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory			

Course L0603: Des	ign of Prestressed Structures and Concreet Bridges		
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	<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>		
	<ul> <li>history of bridges</li> <li>design of 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 Prestressed Structures and Concreet Bridges		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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	6: Soil Mechanic	s and -C	Dynamics			
Courses						
Title Soil Mechanics - Select Soil Dynamics (L0452)		a)	<b>Typ</b> Lectur Lectur		Hrs/wk 2 3	<b>CP</b> 2 2 2
		5)	Flacti	cai Course	1	2
		Prof. Jürgen Grabe				
Admission Requirements						
Recommended Previous		modules: Mathematics I-III, Mechanics I-II, Geotechnics I				
Knowledge	courses: Soil laborator	courses: Soil laboratory course, (Applied structural dynamics)				
		essfully, stud	lents have re	ached the follo	owing learn	ing results
Professional Competence						
Knowledge	<ul> <li>After the successful completion of the module the students should be able to:</li> <li>to derive and to apply the basic equation of a simple mass oscillator,</li> <li>to understand the wave propagation in the soil under dynamic excitation and to detect the relevant parameters,</li> <li>to know the essential laboratory and field tests to determine soil dynamic characteristics and to evaluate them,</li> <li>to design machine foundations to dynamic load,</li> <li>to measure shocks to perform vibration forecast,</li> <li>to evaluate shocks in term to their effect on people and buildings,</li> <li>to evaluate possibilities of isolation,</li> <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> <li>to know the mechanisms that lead to a deformation accumulation due to cyclic loading and to estimate these deformations mathematically,</li> <li>to distinguish the area of application of the method of elastodynamics and plastodynamics,</li> <li>to detect the undrained shear strength as a function of a number of state variables,</li> <li>to capture the visous behaviour of cohesive soils and to consider the effects of creep and rate-dependent shear strength in calculations,</li> <li>to consider the impact of the partly saturated of a seepage and shear strength.</li> </ul>					
<i>Skills</i> Personal Competence	<u>'</u>					
Social Competence	<del>-</del>					
Autonomy	:					
<b>Workload in Hours</b>	Independent Study Tin	ne 96, Study	/ Time in Lect	ure 84		
Credit points	6					
Course achievement		Form Subject practical v	theoretical vork	<b>Descrip</b> and	tion	
Examination	Written exam					
Examination						

duration and scale	
Assignment for	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
the Following	Civil Engineering: Specialisation Geotechnical Engineering: Compulsory
Curricula	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory

Course L0374: Soil	Mechanics - Selected Topics
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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		
СР	2		
Workload in Hours	ndependent Study Time 18, Study Time in Lecture 42		
Lecturer	Alexander Chmelnizkij		
Language			
Cycle			
	mass-spring-damper systems,		
	wave propagation in soils,		
	dynamic soil parameters,		
	Determination of dynamic soil parameters,		
	machine foundations,		
Content	<ul> <li>in-situ measurement of ground motion, ground motion prediction, evaluation of ground motion,</li> </ul>		
	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: Exp	erimental 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	
Content	<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> <li>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.</li> <li>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.</li> </ul>
Literature	<ul> <li>Grabe, J. (2004): Bodenmechanik und Grundbau, Band 3 der Veröffentlichungsreihe des Instituts für Geotechnik und Baubetrieb, Technische Universität Hamburg-Harburg.</li> <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 - Eindimensionaler Kompressionsversuch, Deutsches Institut für Normung, e. V.</li> <li>DIN 18137-2:2011-04: Baugrund, Untersuchung von Bodenproben - Bestimmung der Scherfestigkeit - Teil 2: Triaxialversuch, Deutsches Institut für Normung e. V.</li> </ul> </li> </ul>

Module M0807	7: Boundary Elen	nent Metho	ds		
Courses					
Title Boundary Element Met			<b>Typ</b> Lecture Recitation	Hrs/wk 2 Section 2	<b>CP</b> 3
Boundary Element Met	.nods (LU524)		(large)	2	3
Module Responsible	Prof. Otto von Estorii				
Admission Requirements	None				
Recommended Previous Knowledge	Mechanics I (Statics, Kinematics, Dynamics) Mathematics I, II, III (in				lydrostatics,
Educational Objectives	After taking part succes	ssfully, students h	ave reached th	ne following learn	ing results
Professional Competence					
Knowledge	The students possess boundary element met methodical basis of the	hod and are able			
Skills	The students are capal boundary elements, ass resulting system of equ	sembling the corre			
Personal Competence Social Competence	Students can work in sr	mall groups on spo	ecific problems	s to arrive at joint	solutions.
Autonomy	The students are able and develop own boun results are critically scre	idary element roi			
Workload in Hours	Independent Study Time	e 124 Study Time	n Lecture 56		
Credit points	<u>.                                      </u>	, 5.233	55541 € 50		
Course achievement	CompulsorBonus No 20 %	<b>Form</b> Midterm	De	escription	
Examination	Written exam				
Examination duration and scale					
	Civil Engineering: Speci Civil Engineering: Speci Civil Engineering: Speci Energy Systems: Core o	alisation Geotech alisation Coastal	nical Engineer Engineering: E	ing: Elective Com lective Compulso	pulsory

	Mechanical Engineering and Management: Specialisation Product Development and					
Assignment for	Production: Elective Compulsory					
the Following	Mechatronics: Specialisation System Design: Elective Compulsory					
Curricula	Mechatronics: Specialisation System Design: Elective Compulsory Product Development, Materials and Production: Core qualification: Elective					
•	Compulsory					
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective					
	Compulsory					
	Theoretical Mechanical Engineering: Specialisation Simulation Technology: Elective					
	Compulsory					

Course L0523: Boundary Element Methods		
Тур	Lecture	
Hrs/wk	2	
СР	3	
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Otto von Estorff	
Language	EN	
Cycle	SoSe	
Content	<ul> <li>Boundary value problems</li> <li>Integral equations</li> <li>Fundamental Solutions</li> <li>Element formulations</li> <li>Numerical integration</li> <li>Solving systems of equations (statics, dynamics)</li> <li>Special BEM formulations</li> <li>Coupling of FEM and BEM</li> <li>Hands-on Sessions (programming of BE routines)</li> <li>Applications</li> </ul>	
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 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	

Module M0827: Modeling in Water Management					
Courses					
Title	using Modflow (L0543)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b>	
_	using Modflow (L0544)	Recitation Sectio (small)	<sup>n</sup> 2	2	
Modeling of Water Sup	ply and Sewer Network (L0875)	Project-/problem- based Learning	2	3	
Admission Requirements	None				
	Groundwater				
	<ul> <li>groundwater hydraulics and trans</li> </ul>	nsport of substances			
Recommended	Pipe Systems				
Previous Knowledge					
Educational Objectives	After taking part successfully, students	have reached the follo	wing learn	ing results	
Professional Competence					
Knowledge	The students are able to describe the modelling of groundwater flow and transport as well as urban water infrastructures. They can carry out systems analyses and can detect technical and conceptual weak points within the systems in case studies. Besides they are able to analyse interdependencies of hydraulic and toxic phenomena in soil and water.				
Skills	The students are able to construct and apply scientific groundwater models indipendently. They can work on different scenarios and can compare or assess different solutions for existing problems by application of selected software products. The students are able to use different software solutions (e.g. EPANET, EPA-SWMM).				
Personal Competence					
Social Competence	Wird nicht vermittelt.				
Autonomy	Wird nicht vermittelt.				
	Independent Study Time 110, Study Ti	me in Lecture 70			
Credit points					
Course achievement	None				
Examination					
Examination duration and scale	20 min				

Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Water and Environmental Engineering: Specialisation Water: Compulsory Water and Environmental Engineering: Specialisation Environment: Elective					
Water and Environmental Engineering: Specialisation Environment: Elective Compulsory Water and Environmental Engineering: Specialisation Cities: Elective Compulsory					

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

Course L0544: Groundwater Modeling using Modflow		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Sonja Götz (geb. Schröter)	
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			
<b>Workload in Hours</b>	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 M0828	8: Urban Environmen	ital Manage	ment		
Courses					
<b>Title</b> Noise Protection (L110	Title Noise Protection (L1109)			Hrs/wk 2	<b>CP</b> 2
Urban Infrastructures (	(L0874)		ct-/problem- d Learning	2	4
Module Responsible	THE HOPOTOBA RECOTEDURACO				
Admission Requirements	LNODE				
Recommended Previous Knowledge	Knowledge on measure	es for climate prot			
Educational Objectives	I ATTOR TAKING NART CHICCOCCILIIIV	students have re	eached the follo	owing learn	ing results
Professional Competence					
-	Students can describe urban development corridors as well as current and future urban environmental problems. They are able to 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 urban life. They can, for example, derive and discuss measures for effective noise abatement.				
Skills	Students are able to develop specific solutions for correcting existing or future environment-related problems of urban development. They can define a range of conceptual and technical solutions for environmental problems for different development paths. To solve specific urban environmental problems they can select technical innovations and integrate them into the urban context.				
Personal Competence					
	The students can work togeth	er in internationa	al groups.		
Autonomy	Students are able to organize their work flow to prepare themselves for presentations and contributions to the discussions. They can acquire appropriate knowledge by making enquiries independently.				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Course achievement	LNODE				
Examination	Written elaboration				
Examination duration and scale	Written Report plus oral Presentation				
Assignment for the Following Curricula	qualification: Compulsory				

Compulsory Water and Environmental Engineering: Specialisation Cities: Compulsory

Course L1109: Noise Protection	
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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 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.

Module M0859	9: Coastal Hydraulic Engine	ering II		
Courses				
Title Coastal- and Flood Protection (L0808)		<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3
Coastal- and Flood Pro	tection (L1415)	Project-/problem- based Learning	1	1
Maintennance and Def	ence of Flood Protection Structures (L1411)	Lecture	2	2
Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Knowledge	Coastal Engineering I			
Educational Objectives	After taking part successfully, students h	ave reached the fol	lowing learn	ing results
Professional Competence				
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 important coastal protection measures from the functional and from the constructional point of view.			
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 of coastal and flood protection structures. 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 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 scale	The duration of the examination is 130 respect to the general understanding of			
the Following	Civil Engineering: Specialisation Structur Civil Engineering: Specialisation Geotech Civil Engineering: Specialisation Coastal	nical Engineering: E	Elective Com	

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

Course L1415: Coastal- and Flood Protection	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	1
<b>Workload in Hours</b>	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
<b>Workload in Hours</b>	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

Module M0860	): Harbour Engineering a	nd Harbour Pla	nning	
Courses				
<b>Title</b> Harbour Engineering (I	L0809)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 2
Harbour Engineering (I	L1414)	Project-/problem- based Learning	1	2
Port Planning and Port	Construction (L0378)	Lecture	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous Knowledge	Basics of coastal engineering			
Educational Objectives	After taking part successfully, studer	nts have reached the f	ollowing learn	ing results
Professional Competence				
Knowledge	The students are able to define in details and to choose design approaches for the functional design of a port and apply them to design tasks. They can design the fundamental elements of a port.			
Skills	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. 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 problems.			
<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale	The duration of the examination is 150 min. The examination includes tasks with respect to the general understanding of the lecture contents and calculations tasks.			
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective 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 Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory			

Course L0809: Harbour Engineering	
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
Fundamentals of harbor engineering	
Literature	Brinkmann B : Seehäfen Springer 2005
Literature	Brinkmann, B.: Seehäfen, Springer 2005

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

Course L0378: Port Planning and Port Construction		
Тур	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	<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	

Module M0863	L: Modelling of Hydraulic Er	ngineering		
Courses				
Title		Тур	Hrs/wk	СР
Hydraulic Models (L08:	13)	Project-/problem- based Learning	1	1
Modelling of Waves (LC	0812)	Project-/problem- based Learning	1	1
Modelling of Flow in Ri	vers and Estuaries (L0810)	Lecture	3	4
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous Knowledge	Coastal Hydraulic Engineering I			
Educational Objectives	After taking part successfully, students	have reached the foll	owing learn	ing 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 flows and waves.			
Skills	Students are able to apply hydrodynamic-numerical models to practical hydraulic engineering tasks.			
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in simple applied problems. Additionaly, they will be able to work in team with others.			
Autonomy	The students will be able to independently extend their knowledge and apply it to new problems.			
<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	The duration of the examination is 3 l respect to the general understanding of			
the Following	Civil Engineering: Specialisation Structu Civil Engineering: Specialisation Geotec Civil Engineering: Specialisation Coastal	hnical Engineering: E	ective Com	pulsory

Course L0813: Hydraulic Models		
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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>	
Literature	Strobl, Zunic: Wasserbau, Kap. 11 Hydraulische Modelle, Springer	

Course L0812: Mod	elling of Waves
	Project-/problem-based Learning
Hrs/wk	
СР	
<b>Workload in Hours</b>	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 Flow in Rivers and Estuaries	
Тур	Lecture
Hrs/wk	3
СР	4
<b>Workload in Hours</b>	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Dr. Edgar Nehlsen, Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	Basics of numerial models / application of models
Literature	<ul> <li>Time step procedure</li> <li>Finite differences</li> <li>Finite volumes</li> </ul> Vorlesungsskript

Module M0874	1: Wastewater Systems			
Courses				
<b>Title</b> Wastewater Systems -	Collection, Treatment and Reuse (L0934)	Typ Lecture Recitation	Hrs/wk 2	<b>CP</b> 2
Wastewater Systems -	Collection, Treatment and Reuse (L0943)	(large)	Section 1	1
Advanced Wastewater		Lecture Recitation	2 Section <sub>1</sub>	2
Advanced Wastewater	Treatment (L0358)	(large)	1	1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
	Knowledge of wastewater managem wastewater treatment.	nent and the	key processes	involved in
Educational Objectives	After taking part successfully, students	have reached t	the following learr	ning results
Professional Competence				
Knowledge	Students are able to outline key area waste water management, as well as water protection. They can describe refactors.	s their mutual	dependence for	sustainable
Skills	Students are able to pre-design and opprocesses and the scope of their apple treatment plants.	explain the avaication in muni	ailable wastewate icipal and for son	er treatment ne industrial
Personal Competence				
Social Competence	Social skills are not targeted in this mod	dule.		
Autonomy	Students are in a position to work on independently. They can also present o		d to organize the	ir work flow
<b>Workload in Hours</b>	Independent Study Time 96, Study Time	e in Lecture 84		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following Curricula	Civil Engineering: Specialisation Structure Civil Engineering: Specialisation Geotect Civil Engineering: Specialisation Coasta Civil Engineering: Specialisation Water & Bioprocess Engineering: Specialisation Compulsory Energy and Environmental Engineering Elective Compulsory Environmental Engineering: Specialisation International Management and Engineering: Elective Counternational Management and Eng	chnical Enginee I Engineering: E and Traffic: Cor A - General Bic g: Specialisatio ion Water: Elect gineering: Specialisory ering: Specialis	ring: Elective Com Elective Compulso mpulsory oprocess Engineer n Environmental tive Compulsory ecialisation II. I	npulsory ory oring: Elective Engineering: Energy and

Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory
Process Engineering: Specialisation Process Engineering: Elective Compulsory
Water and Environmental Engineering: Specialisation Water: Compulsory
Water and Environmental Engineering: Specialisation Environment: Elective Compulsory
Water and Environmental Engineering: Specialisation Cities: Compulsory

Course L0934: Was	tewater Systems - Collection, Treatment and Reuse
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
Content	<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: Was	Course L0943: Wastewater Systems - Collection, Treatment and Reuse	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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: Adv	anced 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	SoSe
	Survey on advanced wastewater treatment
	reuse of reclaimed municipal wastewater
	Precipitation
	Flocculation
Comtont	Depth filtration
Content	Membrane Processes
	Activated carbon adsorption
	Ozonation
	"Advanced Oxidation Processes"
	Disinfection
	Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003
Literature	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: Adv	anced Wastewater Treatment
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Joachim Behrendt
Language	EN
Cycle	SoSe
	Aggregate organic compounds (sum parameters)
	Industrial wastewater
	Processes for industrial wastewater treatment
	Precipitation
Content	Flocculation
	Activated carbon adsorption
	Recalcitrant organic compounds
	Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003
	Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987
	Membranverfahren: Grundlagen der Modul- und Anlagenauslegung, T. Melin und R. Rautenbach, Springer-Verlag, Berlin 2007
	Trinkwasserdesinfektion: Grundlagen, Verfahren, Anlagen, Geräte, Mikrobiologie, Chlorung, Ozonung, UV-Bestrahlung, Membranfiltration, Qualitätssicherung, W. Roeske, Oldenbourg-Verlag, München 2006
	Organische Problemstoffe in Abwässern, H. Gulyas, GFEU, Hamburg 2003

Module M0922	2: City Planning			
Courses				
<b>Title</b> City Planning (L1066)		<b>Typ</b> Project-/problem-based Learning	Hrs/wk	<b>CP</b> 6
Module Responsible	Prof. Carsten Gertz			
Admission Requirements	None			
Previous	for "Principles of Urban Planning": none for "Designing Urban Streetscapes": so through taking the undergraduate Engineering"			
Educational Objectives	After taking part successfully, students h	ave reached the fol	llowing learn	ing results
Professional Competence				
Knowledge	<ul> <li>use technical terms of urban plann</li> <li>describe the main determinants of</li> <li>explain and compare different pos</li> </ul>	urban developmer sibilities of how urk eetscapes.		ment can be
Skills	Students are able to:  • read and analyze urban developme • appraise such concepts in the conf • design, justify and reflect their own	text of competing r	equirements	· 5.
Personal Competence				
Social Competence	<ul> <li>discuss intermediate results with e</li> <li>constructively accept feedback on</li> <li>provide constructive feedback to o</li> </ul>	their own work.		
Autonomy	Students are able to:  • independently complete a writted broadly pre-defined process.  • assess the consequences of their process independently acquire knowledged areas.	proposed solutions.	_	_
Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56		
	I			

Credit points	6
Course achievement	INONE
Examination	Written elaboration
Examination duration and scale	written assignment, designwork during the semester
Assignment for the Following Curricula	Logistics, intrastructure and Mobility: Specialisation intrastructure and Mobility:

Course L1066: City	Planning
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Carsten Gertz
Language	DE
Cycle	SoSe
Content	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.

of the main te management s and disadvant ristics of product consequences fo structions logistic life cycle assessr	(small) Lecture Project-/problem based Learning  have reached the  rms of construction s s from other log  ments f construction lo	e following lear	2 2 1 1 1 rning results constructions f constructions
of the main te management is and disadvant ristics of product consequences fo structions logistic	Recitation (small) Lecture Project-/problem based Learning  ave reached the rms of construction so from other logues of the reached so from other logues from the reached the reached so from other logues from the reached the reached so from other logues from the reached the reached so from other logues from the reached the reached so from the reached the reached so from the reached so	Section 1  1  1  n- 1  e following lear  uction logistics  al or external d production of specific supply of gistics systems	1 1 rning results and project construction f construction
of the main te management is and disadvant ristics of product consequences fo structions logistic	Lecture Project-/problem based Learning  ave reached the tages of intern tages of intern ts, demand and r construction s from other log	e following lear	ning results and projections construction chains
of the main te management is and disadvant ristics of product consequences fo structions logistic	rms of construction so from other log	e following lear	rning results and project construction f construction
of the main te management is and disadvant ristics of product consequences fo structions logistic	rms of constru tages of intern ts, demand and r construction s s from other log	action logistics  al or external  d production of  specific supply gistics systems	and project construction construction
of the main te management is and disadvant ristics of product consequences fo structions logistic	rms of constru tages of intern ts, demand and r construction s s from other log	action logistics  al or external  d production of  specific supply gistics systems	and project construction construction
of the main te management is and disadvant ristics of product consequences fo structions logistic	rms of constru tages of intern ts, demand and r construction s s from other log	action logistics  al or external  d production of  specific supply gistics systems	and project construction construction
of the main te management is and disadvant ristics of product consequences fo structions logistic	rms of constru tages of intern ts, demand and r construction s s from other log	action logistics  al or external  d production of  specific supply gistics systems	and project construction construction
management is and disadvant ristics of product consequences fo structions logistic life cycle assessr and instruments of	tages of intern es, demand and r construction s s from other log ments f construction lo	al or external d production of specific supply gistics systems	construction f construction chains
management is and disadvant ristics of product consequences fo structions logistic life cycle assessr and instruments of	tages of intern es, demand and r construction s s from other log ments f construction lo	al or external d production of specific supply gistics systems	construction f construction chains
nd instruments of	construction lo		
nd instruments of nd instruments of d waste removal	conflict manag	pment and mai Jement	_
s in and for grou conflict solving s		ork and case s	tudies
eativity, negotiat	ion skills, confli	ict and crises	solution skil
2 124, Study Time	e in Lecture 56		
of h	of conflict solving so	of conflict solving skills in group we by holistic, systemic and flow orie reativity, negotiation skills, confl	of conflict solving skills in group work and case solving skills in group work and case solving skills, solving solving skills, conflict and crises shods of moderation in case studies

scale	
Assignment for the Following Curricula	Liective Compulsory  International Management and Engineering, Specialisation II, Logistics, Floative

Course L1163: Cons	struction Logistics		
Тур	Lecture		
Hrs/wk	1		
СР	2		
<b>Workload in Hours</b>	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:		
Flämig, Heike: Produktionslogistik in Stadtregionen. In: Forschungsverlökologische Mobilität (Hrsg.) Forschungsbericht Bd. 15.2. Wuppertal 2000.  Krauss, Siri: Die Baulogistik in der schlüsselfertigen Ausführung, Bauwerk VolgmbH Berlin 2005.  Lipsmeier, Klaus: Abfallkennzahlen für Neubauleistungen im Hochbau : Volgerum für Abfallwirtschaft und Altlasten, 2004.  Literature  Schmidt, Norbert: Wettbewerbsfaktor Baulogistik. Neue Wertschöpfungspotent in der Baustoffversorgung. In: Klaus, Peter: Edition Logistik. Band 6. Deutsverkehrs-Verlag. Hamburg 2003.  Seemann, Y.F. (2007): Logistikkoordination als Organisationseinheit bei Bauausführung Wissenschaftsverlag Mainz in Aachen, Aachen. (Mitteilungen dem Fachgebiet Baubetrieb und Bauwirtschaft (Hrsg. Kuhne, V.): Heft 20)			

Course L1164: Construction Logistics		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
<b>Workload in Hours</b>	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 Development and Management			
Тур	Lecture		
Hrs/wk	1		
СР	1		
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei		
Language	DE		
Cycle	SoSe		
	Within the lecture, the main aspects of project development and management are tought:		
Content	<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 Development and Management		
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0998: Statics and Dynamics of Structures				
Courses				
Title		Тур	Hrs/wk	СР
Structural Dynamics (L1202)		Lecture	2	2
Structural Dynamics (L1203)		Recitation	Section 2	2
Fracture mechanics ar	nd fatigue in steel structures (L0564)	(large) Lecture	1	1
Fracture Mechanics an		Recitation (large)	Section 1	1
Module Responsible	Prof. Uwe Starossek			
Admission Requirements	None			
Recommended	Knowledge of linear structural analysis of statically determinate and indeterminate structures; Mechanics I/II, Mathematics I/II, Differential equations I			
Educational Objectives	After taking part successfully, stude	ents have reached	the following learr	ing results
Professional Competence				
Competence	After successful completion of th aspects of dynamic effects on struc			n the bas
Knowledge				
Skills	After successful completion of this response of material and structur computational approaches and met	res to dynamics		
Personal Competence	Students can			
Social Competence	<ul> <li>participate in subject-specific and interdisciplinary discussions,</li> <li>defend their own work results in front of others</li> <li>promote the scientific development of colleagues</li> <li>Furthermore, they can give and accept professional constructive criticism</li> </ul>			
Autonomy	Students are able to gain knowle sources and apply it to new proble solution process for problems in the	ms. Furthermore,	they are able to s	
Workload in Hours	Independent Study Time 96, Study	Time in Lecture 84	ļ	
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale				
	Civil Engineering: Specialisation Str	uctural Engineerin	g: Compulsory	

Assignment for the Following Curricula

Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory
Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
Civil Engineering: Specialisation Water and Traffic: Elective Compulsory
International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory

Course L1202: Structural Dynamics			
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> progressive collapse		
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	
<b>Workload in Hours</b>	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	

Course L0564: Fracture mechanics and fatigue in steel structures		
Тур	Lecture	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Ingo Hadrych	

Language	I <sub>DE</sub>
Cycle	SoSe
	<ul> <li>basics of fatigue stress and fatigue resistance and determination of fatigue strength,</li> </ul>
	determination anduse of S-N-curves and classification of notch effects,
	<ul> <li>set up of determination of fatigue strength under dynamic load using the accumulation formula by Palmgren-Miner,</li> </ul>
Content	set up of determination of fatigue strength in different examples,
	basics of construction and design regarding the problem of material fatigue,
	basics of linear elastic fracture mechanics under static and dynamic load,
	<ul> <li>determination of lifetime of steel construction based on linear elastic fracture mechanics in different examples.</li> </ul>
	<ul> <li>Seeßelberg, C.; Kranbahnen - Bemessung und konstruktive Gestaltung; 3.</li> <li>Auflage; Bauwerk-Verlag; Berlin 2009</li> </ul>
	<ul> <li>Kuhlmann, Dürr, Günther; Kranbahnen und Betriebsfestigkeit; in Stahlbau Kalender 2003; Verlag Ernst &amp; Sohn; Berlin 2003</li> </ul>
	<ul> <li>Deutscher Stahlbau-Verband (Hrsg.); Stahlbau Handbuch Band 1 Teil B; 3.</li> <li>Auflage; Stahlbau-Verlagsgesellschaft; Köln 1996</li> </ul>
	• 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 Bemessungsregeln, Bemessungsregeln für den Hochbau; 1993</li> </ul>
	DIN V ENV 1993-6: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 6: Kranbahnen; 2001
Literature	<ul> <li>DIN-Fachbericht 126. Richtlinie zur Anwendung von DIN V ENV 1993-6;</li> <li>Nationales Anwendungsdokument (NAD); Berlin 2002</li> </ul>

Course L0565: Fracture Mechanics and Fatigue		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Ingo Hadrych	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0999: Steel Construction Project				
Courses				
<b>Title</b> Steel Construction Proj	Typ lect (L1206) Project Se		Hrs/wk 4	<b>CP</b> 6
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous Knowledge	Steel and Composite Structures			
Educational Objectives	After taking part successfully, students have reach	ed the follow	ving learni	ng results
Professional Competence				
	Students are able to prepare a part of the whole project and explain it to the others. Students can produce sketches and calculations of their part of the project. They are able to adjust their work in reaction to changing conditions resulting from other participants of the project.			
Personal Competence		6.11		
Social Competence	Students can present their results to other members of the group.  They have the ability to work for a broad agreement with respect to intergroup dependencies.  They can distribute and process tasks independently.			
Autonomy	Students can handle their part of the project on the	eir own respo	osibility-	
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lectur	e 56		
Credit points	6			
Course achievement	None			
-	Written elaboration			
Examination duration and scale	approx. 15-20 pages (without appendix)			
the Following	Civil Engineering: Specialisation Geotechnical Engil Civil Engineering: Specialisation Coastal Engineerin Civil Engineering: Specialisation Structural Enginee	ng: Elective (	Compulsor	

Course L1206: Steel Construction Project			
Тур	Project Seminar		
Hrs/wk	4		
СР	6		
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56		
Lecturer	Prof. Marcus Rutner		
Language	DE		
Cycle			
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.		

Module M0663: Marine Geotechnics				
Courses				
Title		Тур	Hrs/wk	СР
Marine Geotechnics (L		Lecture Recitation	1 Section <sub>2</sub>	2
Marine Geotechnics (L		(large)	2	2
Steel Structures in Fou	ndation and Hydraulic Engineering (L1146)	Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous Knowledge	complete modules: Geotechnics I-III, Mat courses: Soil laboratory course	thematics I-III		
Educational Objectives	After taking part successfully, students h	nave reached	the following learr	ning results
Professional Competence <i>Knowledge</i> <i>Skills</i>				
Personal Competence Social Competence				
Autonomy				
	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale				
_	Civil Engineering: Specialisation Geotech Civil Engineering: Specialisation Structur Civil Engineering: Specialisation Coastal Theoretical Mechanical Engineering: Specialisation Coastal Theoretical Mechanical Engineering: Tompulsory Water and Environmental Engineering: Swater and Environmental Eng	ral Engineering Engineering Decialisation Internation	g: Elective Compul Compulsory Maritime Technolo aplementary Cour Cities: Elective Col ation Environmen	gy: Elective se: Elective mpulsory nt: Elective

Course L0548: Marine Geotechnics		
Тур	Lecture	
Hrs/wk	1	
СР	2	
<b>Workload in Hours</b>	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 Geotechnics	
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Jürgen Grabe
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

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

Courses				
Title		Тур	Hrs/wk	СР
Port Logistics (L0686)		Lecture	2	3
Port Logistics (L1473)		Recitation (small)	Section 2	3
Module Responsible	Prof. Carlos Jahn			
Admission Requirements	LNODE			
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, stude	nts have reached t	he following learn	ing results
Professional				
Competence	  Th			
Knowledge	<ul> <li>analyze common planning tas planning) at seaport terminal methods and tools) to solve the identify future developments of innovative seaport terminal manner.</li> </ul>	f seaports (in term nals, as well as th ical context; at types of seapor pment technologies sks (e.g. berth plar s and develop suit nese planning task and trends regard nals and discuss	ne relevant opera t terminals and t es, logistic function nning, stowage pla table approaches s; ling the planning them in a probl	heir specifinal areas); anning, ya (in terms and contr
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 required capacity (parking spaces, equipment requirements, quay w length, port access) on selected terminal types;</li> <li>reliably estimate which boundary conditions influence common logist indicators in the static planning of selected terminal types and to wh extent.</li> </ul>			
Personal Competence	After completing the module, studer		tions of part lastin	tion:
Social Competence	<ul> <li>transfer the acquired knowledge to further questions of port logistics;</li> <li>discuss and successfully organize extensive task packages in small groups;</li> <li>in small groups, document work results in writing in an understandable for and present them to an appropriate extent.</li> </ul>			

Autonomy	<ul> <li>After completing the module, the students are able to</li> <li>research and select specialist literature, including standards, guidelines and journal papers, and to develop the contents independently;</li> <li>submit own parts in an extensive written elaboration in small groups in due time and to present them jointly within a fixed time frame.</li> </ul>		
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56		
Credit points	6		
Course achievement	CompulsorBonus Form Description No 15 % Written elaboration		
Examination	Written exam		
Examination duration and scale			
the Following	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 Naval Architecture and Ocean Engineering: Core qualification: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Maritime Technology: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory		

Course L0686: Por	t Logistics
Тур	Lecture
Hrs/wk	2
СР	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Carlos Jahn
Language	DE
Cycle	SoSe
Content	Port Logistics deals with the planning, control, execution and monitoring of material flows and the associated information flows in the port system and its interfaces to numerous actors inside and outside the port area.  The extraordinary role of maritime transport in international trade requires very efficient ports. These must meet numerous requirements in terms of economy, speed, safety and the environment. Against this background, the lecture Port Logistics deals with the planning, control, execution and monitoring of material flows and the associated information flows in the port system and its interfaces to numerous actors inside and outside the port area. The aim of the lecture Port Logistics is to convey an understanding of structures and processes in ports. The focus will be on different types of terminals, their characteristical layouts and the technical equipment used as well as the ongoing digitization and interaction of the players involved.  In addition, renowned guest speakers from science and practice will be regularly invited to discuss some lecture-relevant topics from alternative perspectives.  The following contents will be conveyed in the lectures:  • Instruction of structures and processes in the port  • Planning, control, implementation and monitoring of material and information flows in the port  • Fundamentals of different terminals, characteristical layouts and the technical equipment used  • Handling of current issues in port logistics
Literature	<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: Por	t 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>

Courses				
Title		Тур	Hrs/wk	СР
Maritime Transport (LC	0063)	Lecture	2	3
Maritime Transport (LC	0064)	Recitation (small)	Section 2	3
Responsible				
Admission Requirements	None			
Recommended Previous Knowledge				
	After taking part successfully, stud	lents have reached	the following lear	ning results
Professional				
Competence				
Knowledge	<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-oriented way;</li> <li>estimate the potential of digitisation in maritime shipping.</li> </ul>			
Skills	The students are able to  determine the mode of tra maritime supply chain; identify possible cost driver proposals for cost reduction record, map and systemati maritime logistics chain, solutions; perform risk assessments o analyse accidents in the relevance in everyday life; deal with current research differentiated way; apply different process ma activity and to work out the	s in a transport cha; cally analyse mate identify possible f human disruptions field of maritime n topics in the fiel	in and recommential and information problems and stothe supply chalogistics and evalud of maritime	id appropriate ion flows of a recommend ain; aluating thei logistics in a
Personal Competence	The students are able to			
Social Competence	<ul> <li>discuss and organise extens</li> <li>document and present the</li> </ul>		in groups;	
	The students are capable to			
	<ul> <li>research and select technic</li> </ul>	al litoraturo, includi	na standards and	quidalinas

Autonomy	<ul> <li>submit own shares in an extensive written elaboration in small groups in due time.</li> </ul>		
<b>Workload in Hours</b>	Independent Study Tim	e 124, Study Time in Le	ecture 56
Credit points	6		
	Compulsor <b>B</b> onus	Form	Description
Course achievement		Subject theoretical practical work	and Teilnahme an einem Planspiel und anschließende schriftliche Ausarbeitung
Examination	Written exam		
Examination duration and scale	120 minutes		
Assignment for the Following Curricula	International Managem Compulsory Logistics, Infrastructur Elective Compulsory Logistics, Infrastructure Elective Compulsory Renewable Energies: Sp Theoretical Mechanical Compulsory	nent and Engineering:  e and Mobility: Special  e and Mobility: Special  pecialisation Wind Energy  Engineering: Specialis	seering: Elective Compulsory Specialisation II. Logistics: Elective ialisation Production and Logistics: alisation Infrastructure and Mobility: gy Systems: Elective Compulsory sation Maritime Technology: Elective al Complementary Course: Elective

Course L0063: Maritime Transport		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Carlos Jahn	
Language	DE	
Cycle	SoSe	
	The general tasks of maritime logistics include the planning, design, implementation and control of material and information flows in the logistics chain ship - port - hinterland. This includes technology assessment, selection, dimensioning and implementation as well as the operation of technologies.	
Content	The aim of the course is to provide students with knowledge of maritime transport and the actors involved in the maritime transport chain. Typical problem areas and tasks will be dealt with, taking into account the economic development. Thus, classical problems as well as current developments and trends in the field of maritime logistics are considered.	
	In the lecture, the components of the maritime logistics chain and the actors involved will be examined and risk assessments of human disturbances on the supply chain will be developed. In addition, students learn to estimate the potential of digitisation in maritime shipping, especially with regard to the monitoring of ships. Further content of the lecture is the different modes of transport in the hinterland, which students can evaluate after completion of the course regarding their advantages and disadvantages.	
Literature	<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: Mar	itime Transport	
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	3	
<b>Workload in Hours</b>	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>	

Module M0583	L: Water Protection			
Courses				
	Nastewater Management (L0226) Nastewater Management (L2008)	<b>Typ</b> Lecture Project Seminar	<b>Hrs/wk</b> 3 3	<b>CP</b> 3 3
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous Knowledge	Good knowledge in urban dra     Good knowledge of wastowat	inage; er treatment technique		properties;
Educational Objectives	After taking part successfully, stude	nts have reached the fo	ollowing learn	ing results
Professional Competence				
Knowledge	The students can describe the basic to the international and Europear processes, substance cycles and assess complex problems related to and wastewater treatment with a symeasures as well as conceptual appropriate the students of the students are supported to the students of the studen	n water sector. They own water morphology in own water protection, subjection water focus on innovation.	can explain detail. They ch as ecosys	limnological are able to tem service
Skills	Students can accurately assess of specific or local context. They can planning of tomorrow's urban wappropriate technical, administration problems.	suggest concrete acti vater cycle. Furtherm	ons to contri ore, they c	bute to the an suggest
Personal Competence	The students can work together in in	nternational groups.		
Social Competence				
	Students are able to organize the discussions. They can acquire a independently.			
Autonomy				
Workload in Hours	Independent Study Time 96, Study	Fime in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Presentation			

Examination duration and scale	Term paper plus presentation
Assignment for the Following Curricula	International Management and Engineering: Specialisation II. Civil Engineering:

Course L0226: Wat	er Protection and Wastewater Management
Тур	Lecture
Hrs/wk	3
СР	3
<b>Workload in Hours</b>	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Content	<ul> <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	
<b>Workload in Hours</b>	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Ralf Otterpohl	
Language	EN	
Cycle	WiSe	
Content		
Literature		

Module M059 Damages	5: Examination of Mate	rials, Struc	tural Condit	ion and
Courses				
Title		Тур	Hrs/wk	СР
	als, Structural Condition and Damages	Lecture	3	4
(L0260) Examination of Materia (L0261)	als, Structural Condition and Damages	Recitation (small)	Section 1	2
itesponsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge about building materials and Building Materials and Building		al science, for exa	mple by the
Educational Objectives	After taking part successfully, studer	ts have reached	the following learn	ing results
Professional				
Competence Knowledge	The students are able to describe construction products in Germany. building material properties are usable the most important testing methods.	They know which	h methods for the	e testing of
Skills	The students are able to responsibly discover the rules for trading and using of building products in Germany.  They are able to chose suitable methods for the testing and inspection of construction products, the examination of damages and the examination of the structural conditions of buildings. They are able to conclude from symptons to the cause of damages. They are able to describe an examination in form of a test report or expert opinion.			
Personal Competence Social Competence	The students can describe the diffe supervisory and certification bodies can describe the different roles of the	within the frame	work of material to	
Autonomy	The students are able to make the specialist knowledge of a very extens		operation steps t	to learn the
<b>Workload in Hours</b>	Independent Study Time 124, Study	Time in Lecture 5	66	
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 min			
the Following	Civil Engineering: Specialisation Structivil Engineering: Specialisation Geodesivil Engineering: Specialisation Coastivil Engineering: Specialisation Waternational Management and Engineering	echnical Enginee stal Engineering: le er and Traffic: Ele	ering: Elective Com Elective Compulso ective Compulsory	pulsory ry

Elective Compulsory Materials Science: Specialisation Engineering Materials: Elective Compulsory

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

Course L0261: Examination of Materials, Structural Condition and Damages		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
<b>Workload in Hours</b>	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	D: Excavation Law and Pro	ojects		
Courses				
Title Subsoil and Underground Engineering Law (L0395) Service Contract and Procurement Law (L1906) Project Geotechnics (L0708)		Typ Hrs/ Lecture 2 Lecture 2 Project-/problembased Learning 2		<b>CP</b> 2 2 2
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 <i>Knowledge</i>				
<i>Skills</i> 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	Oral exam			
Examination duration and scale	15 min			
Assignment for the Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory			

Course L0395: Subsoil and Underground Engineering Law			
Lecture			
2			
2			
Independent Study Time 32, Study Time in Lecture 28			
Prof. Günther Schalk			
DE			
WiSe			
History of Civil Engineering Law (from 1700 BC to 2000 AD)			
<ul> <li>Basics of foundation and excarvation law / engineering law (the participants in the case law of geotechnical law case studies)</li> </ul>			
Legal aspects of technical regulations in civil engineering (with case studies)			
<ul> <li>The civil engineering contract (including checklists for the special civil engineering contract design and execution)</li> </ul>			
<ul> <li>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)</li> </ul>			
• The ground / foundation risk and the systemic risk (also in the European context)			
<ul> <li>The total debt in (low) building law (based on practice-oriented case constellations)</li> </ul>			
<ul> <li>The (construction) conflict, the dispute avoidance models and the construction process (practice-oriented presentation)</li> </ul>			
Folienskript (in der Vorlesung erhältlich)			
weitere Literatur:			
<ul> <li>Englert, Grauvogel und Maurer: Handbuch des Baugrund- und Tiefbaurechts. Werner-Verlag</li> </ul>			

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

Course L0708: Proj	Course L0708: Project Geotechnics		
Тур	Project-/problem-based Learning		
Hrs/wk	2		
СР	2		
<b>Workload in Hours</b>	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 M0619	9: Waste Treatm	ent Techn	ologie	s		
Courses						
Title			Тур		Hrs/wk	СР
Waste and Environmen	ntal Chemistry (L0328)			cal Course	2	2
Biological Waste Treat	ment (L0318)		-	t-/problem- Learning	3	4
Module Responsible	Prof. Kerstin Kuchta					
Admission Requirements	None					
Recommended	chemical and biological	l basics				
	After taking part succes	ssfully, student	s have re	ached the follo	owing learn	ing results
Professional						
Competence	_,					
Knowledge	The module aims possess knowledge concerning the planning of biological waste treatment plants. Students are able to explain the design and layout of anaerobic and aerobic waste treatment plants in detail, describe different techniques for waste gas treatment plants for biological waste treatment plants and explain different methods for waste analytics.					
Skills	The students are able to discuss the compilation of design and layout of plants. They can critically evaluate techniques and quality control measurements. The students can recherché and evaluate literature and date connected to the tasks given in der module and plan additional tests. They are capable of reflecting and evaluating findings in the group.					
Personal Competence	Students can narticin	nate in subjec	st-specific	and interdig	scinlinary	discussions
Social Competence	Students can participate in subject-specific and interdisciplinary discussions, develop cooperated solutions and defend their own work results in front of others and promote the scientific development in front of colleagues. Furthermore, they can give and accept professional constructive criticism.					
Autonomy	Students can independently tap knowledge from literature, business or test reports and transform it to the course projects. They 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 accordance with the potential social, economic and cultural impact.					
Workload in Hours	Independent Study Tim	e 110. Studv T	ime in Le	cture 70		
Credit points		,,	20	<u> </u>		
Course achievement	Compulsor <b>B</b> onus	Form Subject the practical work	oretical	<b>Descript</b> and	tion	
Examination	Presentation	p	-			
Examination						
LAGIIIIIGUUII	I					

duration and scale	Elaboration and Presentation (15-25 minutes in groups)
Assignment for the Following Curricula	Environmental Engineering: Core qualification: Compulsory  International Management and Engineering: Specialisation II Energy and

Course L0328: Waste and Environmental Chemistry		
Typ Practical Course		
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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 Waste Treatment		
Тур	Project-/problem-based Learning	
Hrs/wk	3	
СР	4	
<b>Workload in Hours</b>	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 M0705	5: Groundwater			
Courses				
Title		Тур	Hrs/wk	СР
Geohydraulic and Solute Transport (L0539)		Lecture Recitation	2 Section	2
Geohydraulic and Solu	te Transport (L0540)	(small)	Section 1	1
Simulation in Groundw	rater Hydrology (L0541)	Lecture	1	1
Simulation in Groundw	rater Hydrology (L0542)	Recitation (small)	Section 2	2
Module Responsible	NN			
Admission Requirements	None			
Recommended Previous Knowledge	<ul><li> Ground water hydrology</li><li> Hydromechanics</li></ul>			
Educational Objectives	INTER FARING NAME CHARACTURIN CTUR	ents have reached	the following learn	ing results
Professional Competence				
Knowledge	The students are able to describe the fate of solutes in the subsurface along the path between soil and water body quantitatively and qualitatively. They are able to do this with simulation models.			
Skills	The students are able to describe conceptually movement and storage of water in the unsaturated zone. They are able to analyse pF- functions and Ku functions. They can model transport of solutes in the unsaturated and saturated zoned. They are able to determine dispersiities, sorption coefficients, decay rates and dissolution rates for organic and inorganic substances.			
Personal Competence				
Social Competence	The students can help to each other.			
Autonomy	none			
	Independent Study Time 96, Study	Time in Lecture 84		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale	60 min written exam and written pa	apers		
the Following	Civil Engineering: Specialisation Str Civil Engineering: Specialisation Ge Civil Engineering: Specialisation Co Civil Engineering: Specialisation Wa Process Engineering: Specialisation Compulsory Process Engineering: Specialisation Water and Environmental Engineer Water and Environmental Engineer Compulsory Water and Environmental Engineer	eotechnical Engineer pastal Engineering: ater and Traffic: Ele on Environmental on Process Engineering: Specialisation neering: Specialis	ering: Elective Com Elective Compulso ective Compulsory Process Engineeri ng: Elective Compu Water: Compulsory ation Environmen	ipulsory ry ng: Elective ulsory y nt: Elective

Course L0539: Geohydraulic and Solute Transport		
Тур	Lecture	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Wilfried Schneider	
Language	DE	
Cycle	WiSe	
Content	Pump test analysis, water content-water suction functions, unsaturated hydraulic conductivity function, Brooks-Corey relation, van Genuchten relation, solute transport in unsaturated zone, solute transport and reactions in groundwater	
Literature	Todd; K. (2005): Groundwater Hydrology  Fetter, C.W. (2001): Applied Hydrogeology  Hölting & Coldewey (2005): Hydrogeologie  Charbeneau, R.J. (2000): Groundwater Hydraulics and pollutant Transport	

Course L0540: Geohydraulic and Solute Transport		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Wilfried Schneider	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0541: Sim	ulation in Groundwater Hydrology
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Sonja Götz (geb. Schröter)
Language	DE
Cycle	WiSe
	Basics and theoretical background of simulation models frequently used in science and practise for pumping test analysis, water movement in vadose zone, solute transport in vadose zone, groundwater recharge, solute transport in groundwater
Literature	Handbücher der verwendeten Slumationsmodelle werden bereitgestellt.

Course L0542: Sim	Course L0542: Simulation in Groundwater Hydrology				
Тур	Typ Recitation Section (small)				
Hrs/wk	2				
СР	2				
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28				
Lecturer	Sonja Götz (geb. Schröter)				
Language	DE				
Cycle	WiSe				
Content	See interlocking course				
Literature	See interlocking course				

Module M0713	3: C	oncrete Sti	ruct	ures					
Courses									
Title					Тур		Hrs/wk	, (	
Concrete Structures (L	0579)				Seminar		1	1	
Structural Concrete Me	ember	s (L0577)			Lecture		2	3	3
Structural Concrete Me	ember	rs (L0578)			Recitation (large)	Section	2	2	2
Module Responsible	Prof.	Günter Rombac	ch						
Admission Requirements	None	9							
	Basic	cs of structural a	analys	sis, conception	and dimens	ioning of s	tructura	l cor	ncrete
Recommended Previous Knowledge	Modu	ules: Reinforced	Conc	rete Structures	I+II, Struct	ural Analy:	sis I+II,	Mecl	hanics I+I
Educational Objectives	After	taking part suc	cessf	ully, students h	ave reached	d the follo	wing lea	rnin	g results
Professional									
Competence	Tho	students broade	on the	sir ckille in etru	stural ongin	ooring os	nocially	in t	ha fiold of
Knowledge	build	lings (houses, rodes) design of concre	oofs,	halls). They dis	spose of the	e knowled	ge for t	he c	onception
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									
Social Competence	The s	students are abl	le to c	btain results of	f high qualit	y in teamv	work.		
Autonomy		The students are able to carry out complex conception and dimensioning tasks of structures under the guidance of tutors.							
Wardland in Harre	Indo	aaadaat Ctudu T	Fina a '	110 Ctudy Time	a in Lastura	70			
Workload in Hours Credit points		pendent Study I	ime.	LIU, SLUAY HM	e in Lecture	70			
		npulsor <b>B</b> onus	F	orm		Descripti	ion		
Course achievement		None		resentation		_	den	2	Referate
Examination	Writt	en exam				3 - 3 - 8			
Examination duration and scale									
Assignment for the Following Curricula	Civil Civil Civil Inter	Engineering: Sp Engineering: Sp Engineering: Sp Engineering: Sp rnational Manag tive Compulsory	peciali peciali peciali gemer	sation Geotech sation Coastal sation Water ai	nical Engine Engineering nd Traffic: E	eering: Ele : Elective lective Co	ctive Co Compuls mpulsor	sory y	-

Course L0579: Con	crete 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.

Course L0577: Stru	ictural Concrete Members
Тур	Lecture
Hrs/wk	2
СР	3
	Independent Study Time 62, Study Time in Lecture 28
	Prof. Günter Rombach
Language	
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>
Literature	<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</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,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: Stru	Course L0578: Structural Concrete Members				
Тур	ecitation Section (large)				
Hrs/wk	2				
СР	2				
<b>Workload in Hours</b>	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 M0722	2: Comp	utationa	al Analysis o	f Concre	ete Stru	uctures		
Courses								
<b>Title</b> Computational Analysi	s of Concret	e Structures (	(L0598)	<b>Typ</b> Lecture		Hrs/wk	<b>CP</b> 3	
Computational Analysi	s of Concret	e Structures	(L0599)	Recitation (large)	Section	1	1	
FE-Modeling of Concre	te Structures	s (L0600)		Project-/pro based Lear		2	2	
Module Responsible	Prof. Günte	er Rombach						
Admission Requirements	None							
		vledge in str abs, shear w	ructural analysis a valls).	ınd design o	of reinforce	ed concret	e structures	
Recommended Previous	Lectures '	Concrete St	ructures I und II'					
	Lectures '	Structural A	nalysis I and II'					
	Lecture 'Co	oncrete Stru	ctures'					
Educational Objectives	After takin	g part succe	essfully, students h	nave reache	d the follo	wing learn	ing results	
Professional Competence								
-	The studer	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 problems and results with other students.						
Workload in Hours		nt Study Tin	ne 110, Study Tim	e in Lecture	70			
Credit points	!							
	Compulso	-	Form _		<b>Descript</b> Es ist		ystem mit	
Course achievement	Yes	None	Excercises		TEDDY zu	modellier des Sem	en ster ist ein	
	Yes	None	Attestation		Rechenpr modellier	ogramm	zu	
Examination	Oral exam							
Examination duration and scale								
Assignment for the Following Curricula	Civil Engin Civil Engin	eering: Speceering: Speceering:	cialisation Structur cialisation Geotech cialisation Coastal cialisation Water a	nnical Engine Engineering	eering: Ele j: Elective	ctive Com Compulso	pulsory	

Course L0598: Com	putational Analysis of Concrete Structures					
Тур	Lecture					
Hrs/wk	2					
СР	3					
<b>Workload in Hours</b>	ndependent 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: Com	Course 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-N	Modeling of Concrete Structures
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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			Typ	Hrc/wk			
	Typ Hrs/wk CP Project-/problembased Learning  4 6						
Module Responsible	Prof. Carsten Ger	tz					
Admission Requirements	None						
		of transport plann ng and Traffic Eng	ing, e.g. through takir ineerin	ng the undergr	aduate cla		
Educational Objectives	After taking part	successfully, stude	nts have reached the	following learr	ning results		
Professional Competence	Students are able	e to:					
Knowledge	<ul><li>explain an and land-u</li><li>relate cur</li></ul>	<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	<ul><li>quantify influenced</li><li>comprehentransporta</li></ul>	<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 the results in accordance with scientific conventions.</li> </ul>					
Personal Competence	Students are able	e to:					
Social Competence	<ul> <li>constructive</li> </ul>	ely handle feedba	contents and their teack ck on their own work. c and document these	_			
Autonomy	<ul> <li>Students are able to:</li> <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 for its execution.</li> </ul>						
Workload in Hours	Independent Stud	dy Time 124, Study	Time in Lecture 56				
Credit points							
Course achievement	None						

Examination	Written elaboration
Examination duration and scale	written assignment with presentation during the semester
Assignment for the Following Curricula	Logistics, intrastructure and Mobility: Specialisation intrastructure and Mobility:

Course L1068: Integrated Transportation Planning		
Тур	Project-/problem-based Learning	
Hrs/wk	4	
СР	6	
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Prof. Carsten Gertz, Dr. Philine Gaffron, Jacqueline Bianca Maaß	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>The course will provide students with an understanding of interdependencies between land-use and transportation. Specific topics include a.o.:</li> <li>interactions between transport and the environment and consequent limitations</li> <li>characteristics of integrated planning</li> <li>complex planning processes</li> <li>interdependencies of location choice and mobility behaviour</li> <li>transport and land-use policies</li> <li>project on current issues in transportation studies</li> </ul>	
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				
<b>Title</b> Steel and Composite S	tructures (L1204)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 2
Steel and Composite S	tructures (L1205)	Recitation (large)	Section 2	2
Steel Bridges (L1097)		Lecture	2	2
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	LNIONA			
Recommended Previous Knowledge	Basics of steel construction (i.e.	Steel Structures I and	II, BUBC)	
Educational Objectives	After taking part successfully, st	udents have reached t	he following learr	ing results
Professional Competence Knowledge	After successful completition, students can  • describe the phenomenon of local buckling  • explain warping torsion  • illustrate the behaviour of composite structures  • specify the principles in design of composite structures  • sketch the contructions of steel and composite bridges			
Skills	After successful participation stu      check stiffened and unstif     recognize and verify warp     design composite structure     design bridges and o perf	ffened plated structure ling tosion in strucures res		
Personal				
Competence				
Social Competence Autonomy				
	Independent Study Time 96, Stu	dv Time in Lecture 84		
Credit points	· · · · · · · · · · · · · · · · · · ·	,		
Course achievement	None			
Examination	Written exam			
Examination duration and scale	180 min			
Assignment for the Following Curricula	Civil Engineering: Specialisation	Geotechnical Engineer Coastal Engineering: E Water and Traffic: Elec	ring: Elective Com Elective Compulso ctive Compulsory	ry

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 Composite Structures	
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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: Stee	el Bridges
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
	Dr. Jörg Ahlgrimm
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
Content	- 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. 114</li> </ul>

Module M0969	9: Selected Topics in Civil E	Engineering		
Courses				
	ructures (L1867) onal Project Delivery (L2387) d Concrete Structures (L0596)	Typ Lecture Integrated Lecture Lecture	Hrs/wk 1 2	<b>CP</b> 1 2 1
	d Concrete Structures (L0597)	Recitation Section	n 1	1
Forum I - Geotechnics	and Construction Management (L1634) and Construction Management (L1635) ing Design (L2447) .51) 2)	(large) Seminar Seminar Lecture Seminar Lecture Recitation Section (large)	1 1 2 2 2	1 1 3 2 2
Special topics of civil e	ngineering 1CP (L2378) ngineering 2 LP (L2379) ngineering 3 LP (L2380) 1905)	Lecture	1 2 3 1	1 2 3 1
Module Responsible	Prof. Uwe Starossek			
Admission Requirements	None			
Recommended Previous Knowledge Educational		s have reached the follo	wina learr	ning results
Objectives 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	<ul> <li>Students are able to apply bastructural engineering.</li> </ul>	asic methods in select	ed areas	of civil and
Personal Competence				
Social Competence Autonomy	<ul> <li>Students can chose independen knowledge and skills through the</li> </ul>		y want to o	deepen their
Workload in Hours	Depends on choice of courses			
Credit points				
Assignment for the Following Curricula	Civil Engineering: Specialisation Structor Civil Engineering: Specialisation Geoter Civil Engineering: Specialisation Coast	chnical Engineering: Ele al Engineering: Elective	ective Com Compulso	npulsory

Course L1867: Ana	lysis of Offshore Structures	
Тур	Lecture	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
<b>Examination Form</b>	-	
Examination duration and 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	
Content	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	
	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	
Literature	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	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
<b>Examination Form</b>	laut FSPO	
Examination duration and scale	wird zu Beginn der Lehrveranstaltung festgelegt	
Lecturer	NN	
Language	EN	
Cycle	SoSe	
Content		
Literature		

Course L0596: Des	ign of Prefabricated Concrete Structures
Тур	Lecture
Hrs/wk	
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
<b>Examination Form</b>	Klausur
Examination duration and 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> <li>Broschüren der Fachvereinigung Deutscher Betonfertigteilbau e.V. siehe: www.fdb-fertigteilbau.de www.systembauweise.de</li> </ul>

Course L0597: Design of Prefabricated Concrete Structures		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
<b>Examination Form</b>	Klausur	
Examination duration and scale	Siehe korrespondierende Vorlesung	
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	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
<b>Examination Form</b>	Mündliche Prüfung	
Examination duration and scale	30 min	
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	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
<b>Examination Form</b>	Mündliche Prüfung	
Examination duration and 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	
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28	
<b>Examination Form</b>	Schriftliche Ausarbeitung	
Examination duration and scale	45 Min.	
Lecturer	Prof. Jürgen Grabe, 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	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
<b>Examination Form</b>	Referat	
Examination duration and scale	90 min	
Lecturer	Prof. Torsten Faber	
Language	DE	
Cycle	WiSe	
Content		
Literature		

Course L1152: Glass Structures		
Тур	Lecture	
Hrs/wk	2	
СР	2	
	Independent Study Time 32, Study Time in Lecture 28	
<b>Examination Form</b>	Mündliche Prüfung	
Examination duration and scale		
<u>-</u>	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	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
<b>Examination Form</b>	Mündliche Prüfung	
Examination duration and scale		
Lecturer	Marvin Matzik	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L2378: Special topics of civil engineering 1CP		
Тур		
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
<b>Examination Form</b>	laut FSPO	
Examination duration and scale	wird zu Beginn der Lehrveranstaltung festgelegt	
Lecturer	Dozenten des SD B	
Language	DE	
	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	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
<b>Examination Form</b>	laut FSPO	
Examination duration and scale	wird zu Beginn der Lehrveranstaltung festgelegt	
Lecturer	Dozenten des SD B	
Language	DE	
	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	
<b>Workload in Hours</b>	Independent Study Time 48, Study Time in Lecture 42	
<b>Examination Form</b>	laut FSPO	
Examination duration and scale	wird zu Beginn der Lehrveranstaltung festgelegt	
Lecturer	Dozenten des SD B	
Language	DE	
	WiSe/SoSe	
Content	The course occurs only if required. The content is defined at short notice.	
Literature	Die Literatur wird kurzfristig festgelegt.	

Course L1905: Wind turbine design		
Тур	Lecture	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
<b>Examination Form</b>	Mündliche Prüfung	
Examination duration and scale	30 min	
Lecturer	Dr. Jörn Scheller	
Language	DE	
Cycle	WiSe	
Content		
Literature		

Module M0967	7: Study Work Harbour and Coastal Engineering
Courses	
Title	Typ Hrs/wk CP
Responsible	Prof. Peter Fröhle
Admission Requirements	None
Recommended Previous Knowledge	Subjects of the Port and Coastal Engineering specialisation.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
	The students are able to demonstrate their detailed knowledge in the field of port and coastal engineering. They can exemplify the state of technology and application and discuss critically in the context of actual problems and general conditions of science and society.
Knowledge	The students can develop solving strategies and approaches for fundamental and practical problems in port and coastal engineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic 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	
	The students are able to condense the relevance and the structure of the project work, the work steps and the sub-problems for the presentation and discussion ir front of a bigger group. They can lead the discussion and give a feedback on the project to their colleagues.
Autonomy	The students are capable of independently planning and documenting the work steps and procedures while considering the given deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedback from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology.
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0
Credit points	
Course achievement	None
Examination	Study work
Examination duration and scale	The number of pages depends on the task.
Assignment for the Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Compulsory

Module M0997: Structural Analysis - Selected Topics			
Courses			
_	rame Structure (L1200)	<b>Typ</b> Lecture Lecture Recitation	Hrs/wk CP 2 2 2 2 Section 2
Nonlinear Analysis of F	rame Structure (L1201)	(large)	2 2
Module Responsible	Prof. Uwe Starossek		
Admission Requirements	None		
Recommended Previous Knowledge	Mechanics I/II, Mathematics I/II,	Differential Equations I	
Educational Objectives	After taking part successfully, s	tudents have reached th	ne following learning results
Professional Competence	After successful completion of to figher structural analysis.	chis module, students ca	an explain selected element
Knowledge Skills	After successful completion of	this module, the stud	ents are able to assess the
	premises and the applicability analysis. They are able to use the	of the presented met	hods of advanced structura
Personal Competence			
Social Competence	<ul> <li>Students can</li> <li>participate in subject-spe</li> <li>defend their own work re</li> <li>promote the scientific de</li> <li>Furthermore, they can gi</li> </ul>	sults in front of others velopment of colleagues	5
Autonomy	The students have the opportur problems.	nity to voluntarily and in	dependently work homewor
Workload in Hours	Independent Study Time 96, Stu	udy Time in Lecture 84	
Credit points	6		
Course achievement	None		
Examination Examination duration and scale	Written exam  135 min		
the Following	Civil Engineering: Specialisation Civil Engineering: Specialisation Civil Engineering: Specialisation	Geotechnical Engineeri	ng: Elective Compulsory

Course L1199: Plat	es and Shells		
Тур	Lecture		
Hrs/wk			
СР	2		
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Dr. Jürgen Priebe		
Language	DE		
Cycle	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> <li>Zienkiewicz, O.C. (1977): The Finite Element Method in Enginieering Science. McGraw-Hill, London</li> </ul>		

Course L1200: Non	linear Analysis of Frame Structure
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	WiSe
	-Types of nonlinearity
	-relevance of nonlinear effects on structural analysis
	-comparison and classification of 1 $^{\rm st}$ order theory, 2 $^{\rm nd}$ order theory and 3 $^{\rm rd}$ order theory with regard to the coverage of geometric nonlinearity
	-fundamentals of 2 <sup>nd</sup> order elasticity theory for frame structures
Content	-application of 2 <sup>nd</sup> order elasticity theory using finite elements: common displacement method
Content	-fundamentals of analytical application of 2 $^{\rm nd}$ 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
Literature	

Course L1201: Nonlinear Analysis of Frame Structure		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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	

Module M0801: Water Resources and -Supply				
6				
Courses				
Title Chemistry of Drinking	Water Treatment (L0311)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 1
Chemistry of Drinking Water Treatment (L0311)  Chemistry of Drinking Water Treatment (L0312)		Recitation	Section 1	2
Water Resource Manag		(large) Lecture	2	2
Water Resource Manag		Recitation	Section <sub>1</sub>	1
		(small)	1	1
Module Responsible	Prof. Mathias Ernst			
Admission Requirements				
	Knowledge of water manageme treatment.	ent and the key p	processes involve	ed in water
Educational Objectives		dents have reached t	he following learr	ing results
Professional Competence				
Knowledge	Students will be able to outline key areas of conflict in water management, as well as their mutual dependence for sustainable water supply. They will understand relevant economic, environmental and social factors. Students will be able to explain and outline the organisational structures of water companies. They will be able to explain the available water treatment processes and the scope of their application.			
Skills	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 will 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 s document complex solutions for t	he management and appropriate profess will be able to devel	l treatment of dri sional position, f	nking water. or example
Autonomy	Students will be in a position to this subject.	work on a subject ir	ndependently and	I present on
Workload in Hours	Independent Study Time 96, Study	/ Time in Lecture 84		
Credit points	6			
Course achievement	INONE			
Examination	Written exam			
Examination duration and scale	60 min (chemistry) + presentation	1		
Assignment for	Civil Engineering: Specialisation St Civil Engineering: Specialisation G Civil Engineering: Specialisation W Civil Engineering: Specialisation Co Energy and Environmental Engin	eotechnical Engineer later and Traffic: Con pastal Engineering: E	ring: Elective Com npulsory Elective Compulso	pulsory ry

the Following	Engineering: Elective Compulsory
Curricula	International Management and Engineering: Specialisation II. Energy and
	Environmental Engineering: Elective Compulsory
	Water and Environmental Engineering: Specialisation Water: Compulsory
	Water and Environmental Engineering: Specialisation Environment: Elective
	Compulsory
	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory

Course L0311: Chemistry of Drinking Water Treatment			
Тур	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		
	The topic of this course is water chemistry with respect to drinking water treatment and water distribution		
Content	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.		
	MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John Wiley & Sons, Hoboken, 2005.		
	Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley & Sons, New York, 1996.		
Literature	<b>DVGW (Hrsg.):</b> Wasseraufbereitung - Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004.		
	<b>Jensen, J. N.</b> : A Problem Solving Approach to Aquatic Chemistry. John Wiley & Sons, Inc., New York, 2003.		

Course L0312: Chemistry of Drinking Water Treatment			
Тур	Typ Recitation Section (large)		
Hrs/wk	1		
СР	2		
<b>Workload in Hours</b>	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 Resource Management		
Тур	Lecture	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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 Resource Management		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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	

Module M15 Engineering (A	05: Adaptation to Climate Change in Hydraulic AKWAS)			
Courses				
Title	Typ Hrs/wk CP			
Adaptation to climate	change in hydraulic engineering (L2291) Project-/problem- 4 6 based Learning			
Module Responsible	Prof. Parar Fronia			
Admission Requirements				
Recommended Previous Knowledge	Hydromechanic, Hydraulics     Fundamentals of Coastal Engineering, Coastal, and Flood Protection			
Educational Objectives				
Professional Competence				
Knowledge	<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>			
Skills	<ul> <li>Critical thinking: analysis of processes and relations, assessment of needs for action</li> <li>Creative thinking: development of adaptation strategies and adaptation measures</li> <li>Practical thinking: inclusion of restrictions, application of calculation approaches, methods, numerical models, planning methods</li> <li>Consideration of complex tasks</li> </ul>			
Personal Competence				
Social Competence	<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			
	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement	None			
Examination	Written elaboration			

Examination duration and scale	Preparation of a written report and a presentation of a complex task.
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory 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	roject-/problem-based Learning		
Hrs/wk	4		
СР	6		
<b>Workload in Hours</b>	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	9: Geotechnics II	II			
Courses					
			Тур	Hrs/wk	СР
Numerical Methods in	Geotechnics (L0375)		Lecture	3	3
Advanced Foundation			Lecture	2	2
Advanced Foundation	Engineering (L0498)		Recitation (large)	Section 1	1
Module Responsible	Prof. Jürgen Grabe				
Admission Requirements	None				
Recommended Previous Knowledge					
Educational Objectives	After taking part succe	ssfully, students h	ave reached	the following learr	ning results
Professional Competence					
Knowledge					
Skills					
Personal					
Competence	<b>:</b>				
Social Competence					
Autonomy					
	Independent Study Tim	ne 96, Study Time i	in Lecture 84	ļ	
Credit points	6				
Course	Compulsor <b>B</b> onus	Form		Description	
achievement	Yes None	Subject theore practical work	tical and		
Examination	Written exam				
Examination duration and scale	120 min				
Assignment for the Following Curricula	Civil Engineering: Spec Civil Engineering: Spec Civil Engineering: Spec Civil Engineering: Spec International Managen Elective Compulsory	ialisation Geotechr ialisation Coastal E ialisation Water an	nical Enginee Engineering: nd Traffic: Ele	ering: Compulsory Compulsory ective Compulsory	Engineering:

Course L0375: Numerical Methods in Geotechnics		
Тур	Lecture	
Hrs/wk	3	
СР	3	
<b>Workload in Hours</b>	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 Foundation Engineering			
Тур	Typ Lecture		
Hrs/wk	2		
СР	2		
<b>Workload in Hours</b>	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	Typ Recitation Section (large)		
Hrs/wk	1		
СР	1		
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Jürgen Grabe		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M0858	3: Coastal Hydraulic Er	ginee	ring I		
Courses					
<b>Title</b> Basics of Coastal Engir	neering (L0807)		<b>Typ</b> Lecture	Hrs/wk 3	<b>CP</b> 4
Basics of Coastal Engir	neering (L1413)		Project-/problem- based Learning	1	2
Module Responsible	Prof. Peter Fröhle				
Admission Requirements	None				
Recommended Previous Knowledge	Basics of hydraulic engineering,	hydrolog	y and hydromechar	nics	
Educational Objectives	After taking part successfully, st	udents h	ave reached the foll	owing learn	ing results
Professional Competence					
Knowledge	The students are able to define and explain the basic concepts of coastal engineering and port engineering. They are able to apply the concepts to selected practical problems of coastal engineering. Students can define and determine the basics for design and dimensioning of coastal engineering constructions.				
Skills	The students are capable to apply basic design approaches to selected and predefined design tasks in coastal engineering.				
Personal Competence					
Social Competence	The students are able to deploy their gained knowledge in applied problems such as the design of coastal protection structures. 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.				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and scale	The duration of the examination is 2 hours. The examination includes tasks with respect to the general understanding of the lecture contents and calculations tasks.				
the Following	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Compulsory Civil Engineering: Specialisation Coastal Engineering: Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory				

Course L0807: Basics of Coastal Engineering			
Тур	Lecture		
Hrs/wk	3		
СР	4		
<b>Workload in Hours</b>	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Peter Fröhle		
<b>L</b> anguage	DE		
Cycle	WiSe		
Content	Design-approaches     Filter     Rubble mound constructions     Piles     Vertical constructions		
Literature	Coastal Engineering Manual, CEM  Vorlesungsumdruck		

Course L1413: Bas	Course L1413: Basics of Coastal Engineering	
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	2	
<b>Workload in Hours</b>	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	4: Underground Construc	tions		
Courses				
Title Applied Tunnel Construintroduction to tunnel	construction (L0707)	<b>Typ</b> Lecture Lecture Recitation	Hrs/wk 2 1 Section 1	<b>CP</b> 3 2
Introduction to tunnel	construction (L1811)	(large)	1	1
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous Knowledge	Geotechnics I-II	and environmenta	al engineering:	
Educational Objectives	LATTOR TAKING NART CHECKDESTILLIVE STILLIO	nts have reached	the following learn	ing results
Professional Competence				
Knowledge	Knowledge 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 quay walls. Futhermore, the students get all the neccessary knowledge to design singular construction elements for sheet pile walls and they know how to choose the right construction elements depending on the influencing conditions.			
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 and connections.			
Personal				
Competence Social Competence		roject manageme	nt and design of tu	ınnels.
Autonomy	Capacity for teamwork concerning project management and design of tunnels.  Promotion of independent and creative work flow in the framework of a design exercise.			
<b>Workload in Hours</b>	Independent Study Time 124, Study	Time in Lecture 5	6	
Credit points	6			
Course achievement	None			
	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory 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	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: Intro	oduction to tunnel construction
	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
СР	1
<b>Workload in Hours</b>	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 M051	L: Electricity Generati	on from Wind an	d Hydro Po	wer
Courses				
Title Sustainability Manager Hydro Power Use (L00) Wind Turbine Plants (L Wind Energy Use - Foc	13) 0011)	Typ Lecture Lecture Lecture Lecture Lecture	Hrs/wk 2 1 2 1	CP 1 1 3
	Dr. Isahel Höfer		<del>_</del>	_
Admission Requirements	None			
Recommended Previous Knowledge	Module: Technical Thermodyna	mics II,		
Educational Objectives	After taking part successfully, s	tudents have reached th	e following learn	ing results
Professional Competence		ts can evalain in detail	knowledge of w	ind turbings
Knowledge	By ending this module students can explain in detail knowledge of wind turbines with a particular focus of wind energy use in offshore conditions and can critical comment these aspects in consideration of current developments. Furthermore, they are able to describe fundamentally the use of water power to generate electricity. The students reproduce and explain the basic procedure 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 the application of the theoretical background and are thus able to transfer what they have learned in practice.			
Skills	Students are able to apply the acquired theoretical foundations on exemplary water or wind power systems and evaluate and assess technically the resulting relationships in the context of dimensioning and operation of these energy systems. They can in 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 sources in the context of the emphasis of the lecture material to clear the contents of the lecture and to acquire the particular knowledge about the subject area.			
Workload in Hours	Independent Study Time 96, St	udy Time in Lecture 84		
Credit points	6			
Course achievement	None			
Examination				
Examination duration and scale	2.5 hours written exam + Prens	sentation in sustainability	management	

Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Energy and Environmental Engineering: Specialisation Energy Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Renewable Energy: **Elective Compulsory** International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory Product Development, Materials and Production: Specialisation **Product** Assignment for Development: Elective Compulsory the Following Product Development, Materials and Production: Specialisation Production: Elective Curricula Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Renewable Energies: Core qualification: Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Compulsory Water and Environmental Engineering: Specialisation Cities: Elective Compulsory

Course L0007: Sus	tainability Management		
Тур	Lecture		
Hrs/wk	2		
СР	1		
<b>Workload in Hours</b>	Independent Study Time 2, Study Time in Lecture 28		
Lecturer	Dr. Anne Rödl		
Language	DE		
Cycle	WiSe		
Content	The lecture sustainability management provide an insight into the various aspects and dimensions of sustainability. This content of the course is based on the foundations of environmental assessment; therefore the previous attendance of the lecture environmental assessment is recommended. Various valuation approaches for assessing environmental, economic and social aspects are presented. Their application and use for a sustainability management's discussion is explained by means of short technology examples and is later comprehensively presented through case examples.  • Introduction to the topic of sustainability • Dimensions of sustainability:  • ecology  • economics  • social  • Transition from the environmental assessment for sustainability management  • Case Studies  • Excursion  Objective: The aim of the course is to learn methods for the assessment of sustainability aspects and apply for sustainability management.		
Literature	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: Hyd	ro Power Use
Тур	Lecture
Hrs/wk	1
СР	1
<b>Workload in Hours</b>	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	ecture		
Hrs/wk			
СР	3		
<b>Workload in Hours</b>	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: Win	d Energy Use - Focus Offshore
Тур	Lecture
Hrs/wk	1
СР	1
<b>Workload in Hours</b>	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, Heidelberg, 1997, 3. Auflage</li> <li>Hau, E.: Windkraftanalagen; 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>

Module M1351	L: Construction Pro	ocesses		
Courses				
<b>Title</b> Digital Building (L1908 Lean Construction (L1908 System Dynamics (L1908)	910)	<b>Typ</b> Lecture Lecture Lecture	Hrs/wk 2 2 2	<b>CP</b> 2 2 2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfu	ully, students have reached the	following learn	ing results
Professional Competence				
Knowledge Skills				
Personal Competence Social Competence				
Autonomy				
		6, Study Time in Lecture 84		
Credit points Course achievement	6 None			
Examination	Written exam			
Examination duration and scale	60 min			
Assignment for the Following Curricula	Civil Engineering: Specialis Civil Engineering: Specialis	sation Coastal Engineering: Electorical Engineering Sation Geotechnical Engineering: Esation Structural Engineering: Esation Water and Traffic: Electiv	g: Elective Com lective Compul	pulsory

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

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

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

Module M0593	3: Building Materials and	<b>Building Preser</b>	vation	
Courses				
Title Repair of Structures (L Mineral Building Mater		<b>Typ</b> Lecture Lecture	Hrs/wk 1 2	<b>CP</b> 1 2
_	Building Materials (L0256)	Project-/problem-	1	2
	Building Materials and Damage Process	based Learning ses Lecture	1	1
	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
	Basic knowledge about building ma for example by the modules Princi and Building Materials and Building	ples of Building Materia		
Educational Objectives	After taking part successfully, stude	nts have reached the fo	llowing learn	ing results
Professional Competence				
Knowledge	The students are able to describe the components of mineral building materials and their function in detail and to use them for the manufacture of special mineral building materials. They are able to show the characteristics of mineral building			
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 are able to recognize damages, to assess possible causes, to use the fundamentals of construction preservation and to select repair and strengthening measures.			
Personal Competence	<del>-</del>			
Social Competence	The students are able to develop in small grous the mixture of a special mortar. They present their results to the lecturer and the other students. In a critical discussion they defend and adjust their results. The students are able to manufacture their special building material on the basis of this feedback.			
Autonomy	The students are able to response equipment for their project and to in			
	Independent Study Time 110, Study	Time in Lecture 70		
Credit points				
Course achievement	Yes 20 % Form Subject the practical wo	<b>Descri</b> heoretical and ork	ption	
Examination	· ·			
Examination duration and scale				

Assignment for the Following Curricula

Civil Engineering: Specialisation Geotechnical Engineering: Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory

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

Course L0253: Min	Course L0253: Mineral Building Materials		
Тур	Lecture		
Hrs/wk	2		
СР	2		
<b>Workload in Hours</b>	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	roject-/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		
	Taylor, H.F.W.: Cement Chemistry		
Literature	Springenschmid, R.: Betontechnologie für die Praxis		

Course L0254: Transport Processes in Building Materials and Damage Processes		
Тур	Lecture	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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	

Module M072 Bridges	23: Design of Prestressed Structures and Concrete		
Courses			
	Typ Hrs/wk CP Structures and Concreet Bridges (L0603) Lecture 3 4 Structures and Concreet Bridges (L0604) Recitation (large) 2 2		
Module Responsible	i Prof. Gunter Rompach		
Admission Requirements	None		
	Detailed knowledge on the design of concrete structures.  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 types, their applications and the various loads. They can explain the basic design methods. They can explain the design of a prestressed bridge.		
Skills	The students are able to design reinforced or prestressed concrete bridges.		
Personal Competence			
Social 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		
	Written exam		
Examination duration and scale	180 minutes		
the Following	Civil Engineering: Specialisation Structural Engineering: Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory		

Course L0603: Des	ign of Prestressed Structures and Concreet Bridges		
Тур	Lecture		
Hrs/wk	}		
СР	1		
<b>Workload in Hours</b>	ndependent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Günter Rombach		
Language	DE		
Cycle	SoSe		
Content	<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>		
	<ul> <li>history of bridges</li> <li>design of 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 Prestressed Structures and Concreet Bridges		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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	6: Soil Mechanic	s and -	Dynamic	:s		
Courses						
<b>Title</b> Soil Mechanics - Select Soil Dynamics (L0452)	-		<b>Tyr</b> Lect Lect		Hrs/wk 2 3	<b>CP</b> 2 2
•	nes in Geotechnics (L0706	5)		ctical Course	1	2
Module Responsible	Prof. Jürgen Grabe					
Admission Requirements	None					
	modules: Mathematics	I-III, Mecha	anics I-II, Ge	otechnics I		
Previous Knowledge	courses: Soil laboratory	/ course, (/	Applied strud	ctural dynamics	s)	
Educational Objectives	After taking part succe	ssfully, stu	dents have	reached the fol	llowing learr	ing results
Professional Competence						
Knowledge	• to derive and to • to understand the to detect the relevant to the second to to know the essection of the to design machine to design machine to measure show to evaluate show to evaluate possection understand machine to know method bedding modulus to know the mecyclic loading and to distinguish the plastodynamics, • to detect the unvariables, • to capture the vof creep and ratevaluate to consider the strength.	apply the ne wave prevant parasential laborate foundations are applied to evaluate the second for the second fo	basic equation in meters, oratory and uate them, ions to dyna orm vibration to their effects and intensity mine axial put that lead the these deapplication hear streng aviour of column to the streng aviour of column t	on of a simple of the soil under field tests to simic load, of forecast, ect on people are earthquakes asy, ille capacity, into a deformations may of the method that as a function esive soils and ength in calculations.	mass oscillades of dynamic extending some devaluate on accumulate of elastody on of a number of the considerations,	tor, ccitation and soil dynamic e earthquake the dynamic ation due to continuous and ber of state r the effects
Skills Personal Competence Social Competence Autonomy						
	Independent Study Tim	ne 96, Stud	y Time in Le	ecture 84		
Credit points	6					
Course achievement	<b>CompulsorBonus</b> Yes 15 %	Form Subject practical	theoretica work	<b>Descri</b> and	ption	
Examination	Written exam	-				
Examination						

duration and scale	
Assignment for	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
the Following	Civil Engineering: Specialisation Geotechnical Engineering: Compulsory
Curricula	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory

Course L0374: Soil Mechanics - Selected Topics		
Тур	Lecture	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	rkload 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	<b>wk</b> 3		
СР	<b>P</b> 2		
<b>Workload in Hours</b>	Independent Study Time 18, Study Time in Lecture 42		
Lecturer	Alexander Chmelnizkij		
Language			
Cycle	Cycle SoSe		
	mass-spring-damper systems,		
	wave propagation in soils,		
	dynamic soil parameters,		
	Determination of dynamic soil parameters,		
	machine foundations,		
Content	• 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	
<b>Workload in Hours</b>	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Marius Milatz	
Language	DE	
Cycle	SoSe	
Content	<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> <li>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.</li> <li>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.</li> </ul>	
Literature	<ul> <li>Grabe, J. (2004): Bodenmechanik und Grundbau, Band 3 der Veröffentlichungsreihe des Instituts für Geotechnik und Baubetrieb, Technische Universität Hamburg-Harburg.</li> <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 - Eindimensionaler Kompressionsversuch, Deutsches Institut für Normung, e. V.</li> <li>DIN 18137-2:2011-04: Baugrund, Untersuchung von Bodenproben - Bestimmung der Scherfestigkeit - Teil 2: Triaxialversuch, Deutsches Institut für Normung e. V.</li> </ul> </li> </ul>	

Module M0807	7: Boundary Elen	nent Metho	ds		
Courses					
Title Boundary Element Met			<b>Typ</b> Lecture Recitation	Hrs/wk 2 Section 2	<b>CP</b> 3
Boundary Element Met	nods (L0524)		(large)	2	3
Module Responsible	Prof. Otto von Estorff				
Admission Requirements	None				
Recommended Previous Knowledge	Mechanics I (Statics, Kinematics, Dynamics) Mathematics I, II, III (in				lydrostatics,
Educational Objectives	After taking part succes	ssfully, students h	ave reached th	ne following learn	ing results
Professional Competence					
Knowledge	The students possess boundary element met methodical basis of the	hod and are able			
Skills	The students are capal boundary elements, ass resulting system of equ	sembling the corre			
Personal Competence Social Competence	Students can work in sr	nall groups on spo	ecific problems	s to arrive at joint	solutions.
Autonomy	The students are able and develop own boun results are critically scre	idary element ro			
Workload in Hours	Independent Study Time	e 124. Study Time	e in Lecture 56		
Credit points	<u>.                                      </u>	,			
Course achievement	CompulsorBonus No 20 %	<b>Form</b> Midterm	De	escription	
Examination	Written exam				
Examination duration and scale					
	Civil Engineering: Speci Civil Engineering: Speci Civil Engineering: Speci Energy Systems: Core c	alisation Geotech alisation Coastal	nical Engineer Engineering: E	ing: Elective Com lective Compulso	pulsory

	Mechanical Engineering and Management: Specialisation Product Development and
Assignment for the Following	Production: Elective Compulsory Mechatronics: Specialisation System Design: Elective Compulsory Product Development, Materials and Production: Core qualification: Elective
Curricula	Product Development, Materials and Production: Core qualification: Elective Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory
	Theoretical Mechanical Engineering: Specialisation Simulation Technology: Elective Compulsory

Course L0523: Boundary Element Methods		
Тур	Lecture	
Hrs/wk	2	
СР	3	
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Otto von Estorff	
Language	EN	
Cycle	SoSe	
Content	<ul> <li>Boundary value problems</li> <li>Integral equations</li> <li>Fundamental Solutions</li> <li>Element formulations</li> <li>Numerical integration</li> <li>Solving systems of equations (statics, dynamics)</li> <li>Special BEM formulations</li> <li>Coupling of FEM and BEM</li> <li>Hands-on Sessions (programming of BE routines)</li> <li>Applications</li> </ul>	
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 Element Methods	
Тур	Recitation Section (large)
Hrs/wk	2
СР	3
<b>Workload in Hours</b>	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

Module M0827	7: Modeling in Water Mana	gement		
Courses				
Title	using Modflow (L0543)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b>
_	using Modflow (L0544)	Recitation Section (small)	-	2
Modeling of Water Sup	ply and Sewer Network (L0875)	Project-/problem- based Learning	2	3
Admission Requirements	None			
	Groundwater			
	<ul> <li>groundwater hydraulics and trar</li> </ul>	sport of substances		
Recommended	Pipe Systems			
Previous Knowledge				
Educational Objectives	After taking part successfully, students	have reached the follo	wing learn	ing results
Professional Competence				
·	The students are able to describe the modelling of groundwater flow and transport as well as urban water infrastructures. They can carry out systems analyses and can detect technical and conceptual weak points within the systems in case studies. Besides they are able to analyse interdependencies of hydraulic and toxic phenomena in soil and water.			
Skills	The students are able to construct and apply scientific groundwater models indipendently. They can work on different scenarios and can compare or assess different solutions for existing problems by application of selected software products. The students are able to use different software solutions (e.g. EPANET, EPA-SWMM).			
Personal Competence				
Social Competence	Wird nicht vermittelt.			
Autonomy	Wird nicht vermittelt.			
	Independent Study Time 110, Study Ti	me in Lecture 70		
Credit points				
Course achievement	None			
Examination	Oral exam			
Examination duration and scale	20 min			

## **Assignment for** Curricula

Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory the Following
Water and Environmental Engineering: Specialisation Water and Traffic: Elective Compulsory

Curricula Water and Environmental Engineering: Specialisation Environment: Elective Compulsory Water and Environmental Engineering: Specialisation Cities: Elective Compulsory

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

Course L0544: Groundwater Modeling using Modflow		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Sonja Götz (geb. Schröter)	
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		
<b>Workload in Hours</b>	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 M0828	8: Urban Environmen	ntal Mana	agement		
Courses					
Title Noise Protection (L110	09)		Typ Lecture	Hrs/wk 2	<b>CP</b> 2
Urban Infrastructures (	(L0874)		Project-/problem- based Learning	2	4
Module Responsible	TOE DOPOTORA RECOTENDACO				
Admission Requirements	LNODE				
Recommended Previous Knowledge	Knowledge on measure	es for climate			
Educational Objectives	I ATTOR TAKING NART CHICCOCCILIIIV	, students ha	ve reached the foll	lowing learn	ing results
Professional Competence					
-	Students can describe urban development corridors as well as current and future urban environmental problems. They are able to 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 urban life. They can, for example, derive and discuss measures for effective noise abatement.				
Skills	Students are able to develop specific solutions for correcting existing or future environment-related problems of urban development. They can define a range of conceptual and technical solutions for environmental problems for different development paths. To solve specific urban environmental problems they can select technical innovations and integrate them into the urban context.				
Personal Competence					
	The students can work togeth	er in interna	tional groups.		
Autonomy	Students are able to organize their work flow to prepare themselves for presentations and contributions to the discussions. They can acquire appropriate knowledge by making enquiries independently.				
Workload in Hours	Independent Study Time 124,	Study Time	in Lecture 56		
Credit points	6				
Course achievement	LNODE				
Examination	Written elaboration				
Examination duration and scale	Written Report plus oral Prese	entation			
Assignment for the Following Curricula	qualification: Compulsory				

Compulsory Water and Environmental Engineering: Specialisation Cities: Compulsory

Course L1109: Nois	se 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: Urba	an 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.

Module M0859	9: Coastal Hydraulic Engine	ering II		
Courses				
Title Coastal- and Flood Protection (L0808)		<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3
Coastal- and Flood Pro	tection (L1415)	Project-/problem- based Learning	1	1
Maintennance and Def	ence of Flood Protection Structures (L1411)	Lecture	2	2
- Respensione				
Admission Requirements	None			
Knowledge	Coastal Engineering I			
Educational Objectives	After taking part successfully, students h	ave reached the foll	owing learn	ing results
Professional Competence				
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 important coastal protection measures from the functional and from the constructional point of view.			
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 of coastal and flood protection structures. 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 problems.			
	Independent Study Time 110, Study Time	e in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	The duration of the examination is 130 respect to the general understanding of the second sec			
the Following	Civil Engineering: Specialisation Structur Civil Engineering: Specialisation Geotech Civil Engineering: Specialisation Coastal	nical Engineering: E	lective Com	

Course L0808: Coa	stal- and Flood Protection
Тур	Lecture
Hrs/wk	2
СР	3
<b>Workload in Hours</b>	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  Technical solution for the protection of sandy coasts  Construction in direction of the coast  Constructions perpendicular to the coast  Other Concepst  Calculation approaches and numerical models  Flood Protection  Classification of constructions / measures  Dikes  Dunes  Foreland - constructions  Foreland - constructions  Flood-Protection Walls  Drainage of the hinterland
Literature	Vorlesungsumdruck Coastal Engineering Manual CEM

Course L1415: Coastal- and Flood Protection		
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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	
<b>Workload in Hours</b>	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	

Module M0860	D: Harbour Engineering a	nd Harbour Pla	nning	
Courses				
<b>Title</b> Harbour Engineering (I	L0809)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 2
Harbour Engineering (I	L1414)	Project-/problem- based Learning	1	2
Port Planning and Port	Construction (L0378)	Lecture	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous Knowledge	Basics of coastal engineering			
Educational Objectives	After taking part successfully, studer	nts have reached the f	ollowing learn	ing results
Professional Competence				
Knowledge	The students are able to define in details and to choose design approaches for the functional design of a port and apply them to design tasks. They can design the fundamental elements of a port.			
Skills	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. 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 problems.			
<b>Workload in Hours</b>	Independent Study Time 110, Study	Time in Lecture 70		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale	The duration of the examination is 150 min. The examination includes tasks with respect to the general understanding of the lecture contents and calculations tasks.			
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective 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 Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory			

Course L0809: Harbour Engineering		
Тур	Lecture	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Peter Fröhle	
Language	DE	
Cycle	SoSe	
Content	Fundamentals of harbor engineering	
Literature	Brinkmann R - Soohäfon Springer 2005	
Literature	Brinkmann, B.: Seehäfen, Springer 2005	

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

Course L0378: Port Planning and Port Construction		
Тур	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	<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	

Module M0861	L: Modelling of Hydraul	ic Engineering		
Courses				
Title		Тур	Hrs/wk	СР
Hydraulic Models (L08:	13)	Project-/problem-	1	1
		based Learning Project-/problem-	1	1
Modelling of Waves (LC		based Learning	1	1
	vers and Estuaries (L0810)	Lecture	3	4
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous Knowledge	Coastal Hydraulic Engineering I			
Educational Objectives	After taking part successfully, stud	dents have reached the fol	lowing learn	ing 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 flows and waves.			
Skills	Students are able to apply hydrodynamic-numerical models to practical hydraulic engineering tasks.			
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in simple applied problems. Additionaly, they will be able to work in team with others.			
Autonomy	The students will be able to inde new problems.	pendently extend their kno	owledge an	d apply it to
Workload in Hours	Independent Study Time 110, Stu	dy Time in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	The duration of the examination respect to the general understand			
the Following	Civil Engineering: Specialisation S Civil Engineering: Specialisation G Civil Engineering: Specialisation C	eotechnical Engineering: E	lective Com	pulsory

Course L0813: Hydraulic Models		
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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>	
Literature	Strobl, Zunic: Wasserbau, Kap. 11 Hydraulische Modelle, Springer	

Course L0812: Modelling of Waves		
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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 Flow in Rivers and Estuaries		
Тур	Lecture	
Hrs/wk	3	
СР	4	
<b>Workload in Hours</b>	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Dr. Edgar Nehlsen, Prof. Peter Fröhle	
Language	DE/EN	
Cycle	SoSe	
Content	Basics of numerial models / application of models	
Literature		

Module M0874	1: Wastewater Systems			
Courses				
<b>Title</b> Wastewater Systems -	Collection, Treatment and Reuse (L0934)	Typ Lecture Recitation	Hrs/wk	<b>CP</b> 2
Wastewater Systems -	Collection, Treatment and Reuse (L0943)	(large)	Section 1	1
Advanced Wastewater	Treatment (L0357)	Lecture Recitation	2 Section	2
Advanced Wastewater	Treatment (L0358)	(large)	Section 1	1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
	Knowledge of wastewater managem wastewater treatment.	nent and the	key processes	involved ir
Educational Objectives	After taking part successfully, students	have reached t	he following learr	ning results
Professional Competence				
Knowledge	Students are able to outline key area waste water management, as well a water protection. They can describe r factors.	s their mutual	dependence for	sustainable
Skills	Students are able to pre-design and explain the available wastewater treatment processes and the scope of their application in municipal and for some industrial treatment plants.			
Personal Competence				
Social Competence	Social skills are not targeted in this mod	dule.		
Autonomy	Students are in a position to work on a subject and to organize their work flow independently. They can also 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	120 min			
Assignment for the Following Curricula	Civil Engineering: Specialisation Structucivil Engineering: Specialisation Geotectivil Engineering: Specialisation Coasta Civil Engineering: Specialisation Water Bioprocess Engineering: Specialisation Compulsory Energy and Environmental Engineering Elective Compulsory Environmental Engineering: Specialisat International Management and Engineering: Elective Colliternational Management and Engineering: Blective Colliternational Management and Engineering: Elective Colliternational Management and Engineering: Elective Colliternational Management and Engineering: Elective Compulsor	chnical Engineer I Engineering: E and Traffic: Cor A - General Bio g: Specialisation ion Water: Elect gineering: Specialisory pering: Specialis	ring: Elective Com Elective Compulso npulsory process Engineer n Environmental tive Compulsory ecialisation II. I	npulsory ory ring: Elective Engineering Energy and

Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory
Process Engineering: Specialisation Process Engineering: Elective Compulsory
Water and Environmental Engineering: Specialisation Water: Compulsory
Water and Environmental Engineering: Specialisation Environment: Elective Compulsory
Water and Environmental Engineering: Specialisation Cities: Compulsory

Course L0934: Was	stewater Systems - Collection, Treatment and Reuse
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
Content	<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: Adv	anced 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	
	Survey on advanced wastewater treatment
	reuse of reclaimed municipal wastewater
	Precipitation
	Flocculation
	Depth filtration
Content	Membrane Processes
	Activated carbon adsorption
	Ozonation
	"Advanced Oxidation Processes"
	Disinfection
	Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003
	Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987
Literature	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: Adv	anced Wastewater Treatment
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Joachim Behrendt
Language	EN
Cycle	SoSe
	Aggregate organic compounds (sum parameters)
	Industrial wastewater
	Processes for industrial wastewater treatment
	Precipitation
Content	Flocculation
	Activated carbon adsorption
	Recalcitrant organic compounds
	Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003
	Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987
Literature	Membranverfahren: Grundlagen der Modul- und Anlagenauslegung, T. Melin und R. Rautenbach, Springer-Verlag, Berlin 2007
	Trinkwasserdesinfektion: Grundlagen, Verfahren, Anlagen, Geräte, Mikrobiologie, Chlorung, Ozonung, UV-Bestrahlung, Membranfiltration, Qualitätssicherung, W. Roeske, Oldenbourg-Verlag, München 2006
	Organische Problemstoffe in Abwässern, H. Gulyas, GFEU, Hamburg 2003

Module M0922	2: City Planning			
Courses				
<b>Title</b> City Planning (L1066)		<b>Typ</b> Project-/problem-based Learning	Hrs/wk	<b>CP</b> 6
Module Responsible	Prof. Carsten Gertz			
Admission Requirements	None			
	for "Principles of Urban Planning": none			
Previous	for "Designing Urban Streetscapes": so through taking the undergraduate Engineering"			
Educational Objectives	After taking part successfully, students h	ave reached the fol	llowing learn	ing results
Professional Competence				
Knowledge	<ul> <li>use technical terms of urban plann</li> <li>describe the main determinants of</li> <li>explain and compare different posinfluenced.</li> <li>discuss requirements for public str</li> <li>explain the importance of street defends</li> </ul>	furban developmer sibilities of how urb reetscapes.		ment can be
Skills	Students are able to:  read and analyze urban developm appraise such concepts in the con design, justify and reflect their ow	text of competing r	equirements	· 5.
Personal Competence				
Social Competence	<ul> <li>discuss intermediate results with e</li> <li>constructively accept feedback on</li> <li>provide constructive feedback to c</li> </ul>	their own work.		
Autonomy	Students are able to:  • independently complete a written broadly pre-defined process.  • assess the consequences of their process independently acquire knowledge areas.	proposed solutions.	_	_
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 scale	written assignment, designwork during the semester
Assignment for the Following Curricula	Logistics, intrastructure and Mobility: Specialisation intrastructure and Mobility:

Course L1066: City Planning		
Typ Project-/problem-based Learning		
Hrs/wk		
CP		
	Independent Study Time 124, Study Time in Lecture 56	
	Prof. Carsten Gertz	
Language		
Cycle		
Content	"Principles of Urban Planning" deals with the determinants of urban development and their interactions. Topics include:  • legal framework, • instruments and methods of planning, • functional requirements, • stakeholders and actors • basic design requirements • different planning levels and • historical contexts.	
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.	

Module M0977	7: Construction Logistics	s and Project N	Managem	ent
Courses				
<b>Title</b> Construction Logistics	(L1163)	Typ Lecture	Hrs/w	<b>k CP</b> 2
Construction Logistics	(L1164)	Recitation (small)	Section 1	2
Project Development a	ind Management (L1161)	Lecture	1	1
Project Development a	and Management (L1162)	Project-/probler based Learning		1
Module Responsible	Prof. Heike Flämig			
Admission Requirements	None			
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, stud	ents have reached th	e following lea	arning results
Professional Competence	Students can			
Knowledge	<ul> <li>give definitions of the main terms of construction logistics and project development and management</li> <li>name advantages and disadvantages of internal or external construction logistics</li> <li>explain characteristics of products, demand and production of construction objects and their consequences for construction specific supply chains</li> <li>differentiate constructions logistics from other logistics systems</li> </ul>			
Skills	<ul> <li>carry out project life cycle at</li> <li>apply methods and instrume</li> <li>apply methods and instrume</li> <li>apply methods and instrume</li> <li>design supply and waste rer</li> </ul>	ents of construction lo ents of project develo ents of conflict manag	pment and magement	_
Personal Competence	Students can			
Social Competence			ork and case	studies
Autonomy	Students can  solve problems by holistic, solution improve their creativity, new by applying methods of models.	gotiation skills, confl	ict and crises	
Workload in Hours	Independent Study Time 124, Stud	y Time in Lecture 56		
Credit points	6			
Course achievement	None			
	 Written elaboration			
Examination				
	Two written papers with presentati	ons		

scale	
the Following	Elective Compulsory International Management and Engineering: Specialisation II. Logistics: Elective

Course L1163: Con	struction Logistics
Тур	Lecture
Hrs/wk	1
СР	2
<b>Workload in Hours</b>	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:
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 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: Proj	ect Development and Management
Тур	Lecture
Hrs/wk	1
СР	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei
Language	DE
Cycle	SoSe
	Within the lecture, the main aspects of project development and management are tought:  • Terms and definitions of project management
Content	<ul> <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 Development and Management	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0998	8: Statics and Dynamics	of Structure	S	
Courses				
Title		Тур	Hrs/wk	СР
Structural Dynamics (L	_1202)	Lecture	2	2
Structural Dynamics (L	_1203)	Recitation	Section 2	2
Fracture mechanics ar	nd fatigue in steel structures (L0564)	(large) Lecture	1	1
Fracture Mechanics an	nd Fatigue (L0565)	Recitation (large)	Section 1	1
Module Responsible				
Admission Requirements	LNODE			
	Knowledge of linear structural anal structures; Mechanics I/II, Mathema			determinat
Educational Objectives	After taking part successfully, stude	nts have reached	the following learn	ing results
Professional Competence				n the basi
Knowledge				
Skills	After successful completion of this response of material and structur computational approaches and met	es to dynamics		
Personal Competence	Students can			
Social Competence	<ul> <li>participate in subject-specific</li> <li>defend their own work results</li> <li>promote the scientific develo</li> <li>Furthermore, they can give a</li> </ul>	s in front of others pment of colleagu	es	criticism
Autonomy	Students are able to gain knowle sources and apply it to new proble solution process for problems in the	ms. Furthermore,	they are able to s	
Workload in Hours	Independent Study Time 96, Study	Time in Lecture 84	ļ	
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	150 min			
	Civil Engineering: Specialisation Str	uctural Engineerin	g: Compulsory	

Assignment for the Following Curricula

Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory
Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
Civil Engineering: Specialisation Water and Traffic: Elective Compulsory
International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory

Course L1202: Structural Dynamics		
Тур	Lecture	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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
<b>Workload in Hours</b>	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

Course L0564: Fracture mechanics and fatigue in steel structures		
Тур	Lecture	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Ingo Hadrych	

Language	I <sub>DE</sub>
Cycle	SoSe
	<ul> <li>basics of fatigue stress and fatigue resistance and determination of fatigue strength,</li> </ul>
	determination anduse of S-N-curves and classification of notch effects,
	<ul> <li>set up of determination of fatigue strength under dynamic load using the accumulation formula by Palmgren-Miner,</li> </ul>
Content	• set up of determination of fatigue strength in different examples,
	basics of construction and design regarding the problem of material fatigue,
	basics of linear elastic fracture mechanics under static and dynamic load,
	<ul> <li>determination of lifetime of steel construction based on linear elastic fracture mechanics in different examples.</li> </ul>
	<ul> <li>Seeßelberg, C.; Kranbahnen - Bemessung und konstruktive Gestaltung; 3.</li> <li>Auflage; Bauwerk-Verlag; Berlin 2009</li> </ul>
	<ul> <li>Kuhlmann, Dürr, Günther; Kranbahnen und Betriebsfestigkeit; in Stahlbau Kalender 2003; Verlag Ernst &amp; Sohn; Berlin 2003</li> </ul>
	<ul> <li>Deutscher Stahlbau-Verband (Hrsg.); Stahlbau Handbuch Band 1 Teil B; 3.</li> <li>Auflage; Stahlbau-Verlagsgesellschaft; Köln 1996</li> </ul>
	• Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993
	• DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsregeln, Bemessungsregeln für den Hochbau; 1993
	• DIN V ENV 1993-6: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 6: Kranbahnen; 2001
Literature	DIN-Fachbericht 126. Richtlinie zur Anwendung von DIN V ENV 1993-6; Nationales Anwendungsdokument (NAD); Berlin 2002

Course L0565: Fracture Mechanics and Fatigue		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Ingo Hadrych	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0999	9: Steel Construction Project
Courses	
<b>Title</b> Steel Construction Pro	Typ Hrs/wk CP Project Seminar 4 6
Module Responsible	Prof. Marcus Rutner
Admission Requirements	None
Recommended Previous Knowledge	Steel and Composite Structures
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 whole project and explain it to the others.
Skills	Students can produce sketches and calculations of their part of the project. They are able to adjust their work in reaction to changing conditions resulting from other participants of the project.
Personal	
Competence	
Social Competence	
	They can distribute and process tasks independently.
Autonomy	Students can handle their part of the project on their own resposibility-
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	approx. 15-20 pages (without appendix)
the Following	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Compulsory

Course L1206: Steel Construction Project		
Тур	Project Seminar	
Hrs/wk	4	
СР	6	
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Prof. Marcus Rutner	
Language	DE	
Cycle		
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.	

Module M0663	3: Marine Geotechnics			
Courses				
Title		Тур	Hrs/wk	СР
Marine Geotechnics (L	0548)	Lecture Recitation	1 Section <sub>2</sub>	2
Marine Geotechnics (L	0549)	(large)	2	2
Steel Structures in Fou	ndation and Hydraulic Engineering (L1146)	Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous Knowledge	complete modules: Geotechnics I-III, Mai courses: Soil laboratory course	thematics I-III		
Educational Objectives	After taking part successfully, students h	nave reached	the following learr	ning results
Professional Competence <i>Knowledge</i> <i>Skills</i>				
Personal Competence				
Social Competence Autonomy				
	Independent Study Time 110, Study Tim	e in Lecture 7	0	
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale				
	Civil Engineering: Specialisation Geotech Civil Engineering: Specialisation Structur Civil Engineering: Specialisation Coastal Theoretical Mechanical Engineering: Specialisation Compulsory Theoretical Mechanical Engineering: Tompulsory Water and Environmental Engineering: Special E	ral Engineering: Engineering: Decialisation I Decialisation Engineering: Decialisation Eng: Specialis	g: Elective Compu Compulsory Maritime Technolo uplementary Cour Cities: Elective Co ation Environme	gy: Elective se: Elective mpulsory nt: Elective

Course L0548: Marine Geotechnics			
Тур	Lecture		
Hrs/wk	1		
СР	2		
<b>Workload in Hours</b>	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 Sohn, Berlin</li> </ul>		

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

Course L1146: Steel Structures in Foundation and Hydraulic Engineering		
Тур	Lecture	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Frank Feindt	
Language	DE	
Cycle		
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 M058	1: Water Protection			
Courses				
Title		Тур	Hrs/wk	СР
	Wastewater Management (L0226) Wastewater Management (L2008)	Lecture Project Seminar	3 3	3 3
		Project Seminal	<u> </u>	3
Module Responsible	Prof. Raif Otterponi			
Admission Requirements	None			
Recommended Previous Knowledge	Good knowledge in urban of wastew	drainage; vater treatment techniques;		properties;
Educational Objectives	After taking part successfully, stu	dents have reached the foll	lowing learn	ing results
Professional Competence				
·	The students can describe the batto the international and Europe processes, substance cycles and assess complex problems related and wastewater treatment with a measures as well as conceptual a	ean water sector. They can d water morphology in de d to water protection, such special focus on innovative	an explain etail. They n as ecosys	limnological are able to tem service
Skills	Students can accurately assess specific or local context. They c planning of tomorrow's urban appropriate technical, administration problems.	an suggest concrete actio water cycle. Furthermo	ns to contri re, they c	bute to the an suggest
Personal Competence	The students can work together in	n international groups.		
Social Competence				
Autonomy	Students are able to organize discussions. They can acquire independently.			
Workload in Hours	Independent Study Time 96, Stud	y Time in Lecture 84		
Credit points				
Course achievement	None			
Examination	Presentation			
İ				

Examination duration and scale	Term paper plus presentation
Assignment for the Following Curricula	International Management and Engineering: Specialisation II. Civil Engineering:

Course L0226: Water Protection and Wastewater Management		
Тур	Lecture	
Hrs/wk	3	
СР	3	
<b>Workload in Hours</b>	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Ralf Otterpohl	
Language	EN	
Cycle	WiSe	
Content	<ul> <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>	
<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. edinternat. ed.). Boston [u.a.]: Pearson Education International.</li> <li>Water and wastewater engineering: design principles and practice: Davis, 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
<b>Workload in Hours</b>	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Content	
Literature	

## Module M0595: Examination of Materials, Structural Condition and Damages

Courses				
Title	ala Church wal Can dibian and Danas and	Тур	Hrs/wk	СР
Examination of Materials, Structural Condition and Damages (L0260)		Lecture	3	4
Examination of Materia (L0261)	als, Structural Condition and Damages	Recitation (small)	Section 1	2
Module Responsible	IPROF FRANK SCOMING-DOOL			
Admission Requirements	LNODE			
Recommended Previous Knowledge	module Building Materials and Buildin		l science, for exa	mple by the
Educational Objectives	LATTER TAKING NART SUCCESSIUM STUGENI	s have reached	the following learr	ing results
Professional Competence				
Knowledge	The students are able to describe the rules for trading, use and marking of construction products in Germany. They know which methods for the testing of building material properties are usable and know the limitations and characterics of the most important testing methods.			
Skills	The students are able to responsible building products in Germany. They are able to chose suitable construction products, the examinat structural conditions of buildings. The cause of damages. They are able to report or expert opinion.	methods for th ion of damages ey are able to co	e testing and ir and the examin onclude from sym	nspection of ation of the ptons to the
Personal Competence Social Competence	The students can describe the differ supervisory and certification bodies v	within the frame	work of material t	
Autonomy	The students are able to make the specialist knowledge of a very extens		operation steps	to learn the
	Independent Study Time 124, Study T	ime in Lecture 5	6	
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 min			
Assignment for the Following	Civil Engineering: Specialisation Structivil Engineering: Specialisation Geotocivil Engineering: Specialisation Coastivil Engineering: Specialisation Wate International Management and Eng	echnical Enginee tal Engineering: l r and Traffic: Ele	ring: Elective Com Elective Compulso ctive Compulsory	ipulsory ry

Elective Compulsory Materials Science: Specialisation Engineering Materials: Elective Compulsory

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

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

Module M1350: Excavation Law and Projects				
Courses				
Title Subsoil and Underground Engineering Law (L0395) Service Contract and Procurement Law (L1906) Project Geotechnics (L0708)		<b>Typ</b> Lecture Lecture Project-/problem- based Learning	<b>Hrs/wk</b> 2 2 2	<b>CP</b> 2 2 2
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 <i>Knowledge</i>				
<i>Skills</i> Personal Competence				
Social Competence Autonomy				
Workload in Hours	Independent Study Time 96, Study T	me in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and scale	15 min			
Assignment for the Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory			

Course L0395: Sub	soil and Underground Engineering Law
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Günther Schalk
Language	DE
Cycle	WiSe
	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)
Content	<ul> <li>The civil engineering contract (including checklists for the special civil engineering contract design and execution)</li> </ul>
	<ul> <li>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)</li> </ul>
	• The ground / foundation risk and the systemic risk (also in the European context)
	<ul> <li>The total debt in (low) building law (based on practice-oriented case constellations)</li> </ul>
	• The (construction) conflict, the dispute avoidance models and the construction process (practice-oriented presentation)
Literature	Folienskript (in der Vorlesung erhältlich)
	weitere Literatur:
	<ul> <li>Englert, Grauvogel und Maurer: Handbuch des Baugrund- und Tiefbaurechts. Werner-Verlag</li> </ul>

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

Course L0708: Proj	Course L0708: Project Geotechnics					
Тур	Project-/problem-based Learning					
Hrs/wk	2					
СР	2					
<b>Workload in Hours</b>	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 M0619	9: Waste Treatm	ent Ted	hnologi	es			
Courses							
<b>Title</b> Waste and Environmer	ntal Chemistry (L0328)			tical Course	Hrs/wk	<b>CP</b> 2	
Biological Waste Treati	ment (L0318)			ect-/problem- ed Learning	3	4	
Module Responsible	Prof. Kerstin Kuchta						
Admission Requirements	None						
Recommended	chemical and biological	basics					
Educational Objectives	After taking part succes	ssfully, stu	dents have	reached the foll	lowing learn	ning results	
Professional							
Competence		acc knowle	adae conco	rning the plant	ning of biol	naical wasta	
Knowledge	The module aims possess knowledge concerning the planning of biological waste treatment plants. Students are able to explain the design and layout of anaerobic and aerobic waste treatment plants in detail, describe different techniques for waste gas treatment plants for biological waste treatment plants and explain different methods for waste analytics.						
Skills	The students are able to discuss the compilation of design and layout of plants. They can critically evaluate techniques and quality control measurements. The students can recherché and evaluate literature and date connected to the tasks given in der module and plan additional tests. They are capable of reflecting and evaluating findings in the group.						
Personal Competence	Chudanta an nantisin	-t- i		=	::-!:·	diaawaaiaaa	
Social Competence	Students can participate in subject-specific and interdisciplinary discussions, develop cooperated solutions and defend their own work results in front of others and promote the scientific development in front of colleagues. Furthermore, they can give and accept professional constructive criticism.						
Autonomy	Students can independently tap knowledge from literature, business or test reports and transform it to the course projects. They 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 accordance with the potential social, economic and cultural impact.						
Workload in Hours	 Independent Study Tim	e 110, Stu	dy Time in L	ecture 70			
Credit points							
Course achievement	CompulsorBonus Yes None	Form Subject practical	theoretical work	<b>Descri</b> ption	otion		
Examination	Presentation	-					
Examination							

duration and scale	Elaboration and Presentation (15-25 minutes in groups)
Assignment for the Following Curricula	International Management and Engineering: Specialisation II Energy and

Course L0328: Was	te and Environmental Chemistry
Тур	Practical Course
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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 Waste Treatment					
Тур	Project-/problem-based Learning				
Hrs/wk	3				
СР	4				
<b>Workload in Hours</b>	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 M0705	5: Groundwater					
Courses						
Title		Turn	Hrs/wk	СР		
Geohydraulic and Solu	te Transport (I 0539)	<b>Typ</b> Lecture	nrs/wk	2		
Geohydraulic and Solu		Recitation	Section <sub>1</sub>	1		
•	·	(small) Lecture	1	1		
	ater Hydrology (L0541)	Recitation	Section 2	_		
Simulation in Groundw	ater Hydrology (L0542)	(small)	2	2		
Module Responsible	NN					
Admission Requirements	None					
Recommended Previous Knowledge	<ul><li>Ground water hydrology</li><li>Hydromechanics</li></ul>					
Educational Objectives	After taking part successfully, stude	ents have reached	the following learn	ing results		
Professional Competence						
Knowledge	The students are able to describe path between soil and water body of do this with simulation models.					
Skills	The students are able to describe conceptually movement and storage of water in the unsaturated zone. They are able to analyse pF- functions and Ku functions. They can model transport of solutes in the unsaturated and saturated zoned. They are able to determine dispersiities, sorption coefficients, decay rates and dissolution rates for organic and inorganic substances.					
Personal Competence						
Social Competence	The students can help to each other.					
Autonomy						
	Independent Study Time 96, Study	Time in Lecture 84				
Credit points	6					
Course achievement	None					
Examination	Written exam					
Examination duration and scale	60 min written exam and written pa	pers				
the Following	Civil Engineering: Specialisation Structure Civil Engineering: Specialisation Geoclivil Engineering: Specialisation Cooclivil Engineering: Specialisation Warrocess Engineering: Specialisation Compulsory Process Engineering: Specialisation Water and Environmental Engineering Water and Environmental Engineering Compulsory Water and Environmental Engineering	otechnical Engineerstal Engineerstal Engineering: ter and Traffic: Ele n Environmental Process Engineering: Specialisation neering: Specialis	ering: Elective Com Elective Compulso ective Compulsory Process Engineeri ng: Elective Compu Water: Compulsory ation Environmer	pulsory ry ng: Elective ulsory / nt: Elective		

Course L0539: Geo	Course L0539: Geohydraulic and Solute Transport					
Тур	Lecture					
Hrs/wk	2					
СР	2					
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28					
Lecturer	Prof. Wilfried Schneider					
Language	DE					
Cycle	WiSe					
Content	Pump test analysis, water content-water suction functions, unsaturated hydraulic conductivity function, Brooks-Corey relation, van Genuchten relation, solute transport in unsaturated zone, solute transport and reactions in groundwater					
Literature	Todd; K. (2005): Groundwater Hydrology  Fetter, C.W. (2001): Applied Hydrogeology  Hölting & Coldewey (2005): Hydrogeologie  Charbeneau, R.J. (2000): Groundwater Hydraulics and pollutant Transport					

Course L0540: Geo	Course L0540: Geohydraulic and Solute Transport				
Тур	Recitation Section (small)				
Hrs/wk	1				
СР	1				
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14				
Lecturer	Prof. Wilfried Schneider				
Language	DE				
Cycle	WiSe				
Content	See interlocking course				
Literature	See interlocking course				

Course L0541: Sim	Course L0541: Simulation in Groundwater Hydrology					
Тур	Lecture					
Hrs/wk	1					
СР	1					
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14					
Lecturer	Sonja Götz (geb. Schröter)					
Language	DE					
Cycle	WiSe					
Content	Basics and theoretical background of simulation models frequently used in science and practise for pumping test analysis, water movement in vadose zone, solute transport in vadose zone, groundwater recharge, solute transport in groundwater					
Literature	Handbücher der verwendeten Slumationsmodelle werden bereitgestellt.					

Course L0542: Sim	Course L0542: Simulation in Groundwater Hydrology				
Тур	Recitation Section (small)				
Hrs/wk	2				
СР	2				
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28				
Lecturer	Sonja Götz (geb. Schröter)				
Language	DE				
Cycle	WiSe				
Content	See interlocking course				
Literature	See interlocking course				

Module M0713	3: Co	ncrete St	ructur	es					
Courses									
<b>Title</b> Concrete Structures (L					<b>Typ</b> Seminar		Hrs/wk	<b>C</b>	P
Structural Concrete Me					Lecture Recitation	Section	2	3	
Structural Concrete Me	embers	(L0578)			(large)	Section	2	2	
Module Responsible	Prof.	Günter Rombad	ch						
Admission Requirements	INODE								
-	Basic	s of structural a	analysis,	conception	and dimensi	oning of s	tructural	con	crete
Recommended Previous Knowledge		les: Reinforced	Concrete	e Structures	I+II, Structu	ıral Analy:	sis I+II, M	1ech	anics I+I
Educational Objectives	ΙΔΠΩΓ	taking part suc	cessfully	, students h	ave reached	the follo	wing lear	ning	results
Professional Competence									
Knowledge	buildi	tudents broadengs (houses, resign of concre	oofs, hall	s). They dis	spose of the	knowled	ge for th	e co	nception
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									
Social Competence	The s	tudents are ab	le to obta	in results of	f high quality	/ in teamv	work.		
Autonomy		The students are able to carry out complex conception and dimensioning tasks of structures under the guidance of tutors.							
Workload in Hours	Indep	endent Study 7	Time 110	, Study Time	e in Lecture	70			
Credit points	6								
Course achievement		<b>pulsor₿onus</b> None	<b>Form</b> Prese	<b>n</b> entation	ļ	<b>Descript</b> i Es wer ausgegeb	den 2	<u>!</u>	Referate
Examination	Writte	en exam							
Examination duration and scale	120 n	ninutes							
Assignment for the Following Curricula	Civil E Civil E Civil E Interr	Engineering: Sp Engineering: Sp Engineering: Sp Engineering: Sp national Manag ve Compulsory	pecialisati pecialisati pecialisati gement a	on Geotech on Coastal I on Water ar	nical Engine Engineering: nd Traffic: El	ering: Ele Elective ective Co	ctive Cor Compulsompulsory	ory	-

Course L0579: Concrete Structures					
Тур	Seminar				
Hrs/wk	1				
СР	1				
<b>Workload in Hours</b>	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 L0577: Stru	ictural Concrete Members
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
	Prof. Günter Rombach
Language	
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>
Literature	<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</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,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 Concrete Members		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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 M0722: Computational Analysis of Concrete Structures							
Courses							
Title Computational Analysi	s of Concrete	Structures (	L0598)	Typ Lecture		Hrs/wk	<b>CP</b> 3
Computational Analysi				Recitation (large)	Section	1	1
FE-Modeling of Concre	te Structures	(L0600)		Project-/probler based Learning		2	2
Module Responsible	Prof. Günte	r Rombach					
Admission Requirements	None						
		ledge in str bs, shear w	uctural analysis a alls).	nd design of re	inforce	d concrete	e structures
Recommended Previous	Lectures 'C	Concrete Str	ructures I und II'				
Knowledge	Lectures 'S	tructural Ar	nalysis I and II'				
	Lecture 'Co	ncrete Stru	ctures'				
Educational Objectives	After taking	part succe	ssfully, students h	ave reached th	e follov	ving learn	ing results
Professional Competence							
Knowledge	The studen concrete st	ts know the ructure.	e problems of num	nerical modelin	g and o	design of	an arbitrary
Skills	The studen finite eleme		el and design an e package.	arbitrary concr	ete str	ucture by	means of a
Personal Competence							
Social Competence	The studen of a finite e	ts can mode lement soft	el and design in te ware package.	amwork a real	concret	e structur	e by means
Autonomy			del and design a ckage and discu				
Workload in Hours		nt Study Tim	ne 110, Study Tim	e in Lecture 70			
Credit points	! !						
Course achievement		<b>r₿onus</b> None	<b>Form</b> Attestation	Am Tra Rec	gsyster	des Sem n mi ogramm	ster ist ein t dem zu
	Yes	None	Excercises			in Tragsy modellier	
Examination	Oral exam						
Examination duration and scale							
Assignment for the Following Curricula	Civil Engine Civil Engine	eering: Spec eering: Spec	ialisation Structur ialisation Geotech ialisation Coastal ialisation Water a	nical Engineeri Engineering: El	ng: Ele ective (	ctive Com Compulsor	pulsory

Course L0598: Computational Analysis of Concrete Structures		
Тур	Lecture	
Hrs/wk	2	
СР	3	
<b>Workload in Hours</b>	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: Computational Analysis of Concrete Structures		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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 Concrete Structures		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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>	

Module M080	1: Water Resources and	-Supply		
6				
Courses				
Title Chemistry of Drinking	Water Treatment (L0311)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 1
	Water Treatment (L0312)	Recitation	Section 1	2
Water Resource Manag		(large) Lecture	2	2
Water Resource Manag		Recitation	Section <sub>1</sub>	1
		(small)	1	1
Module Responsible	Prof. Mathias Ernst			
Admission Requirements				
	Knowledge of water manageme treatment.	ent and the key p	processes involve	ed in water
Educational Objectives	LATTER TAKING NART CHCCECCTIIIIV CTHC	dents have reached t	he following learn	ing results
Professional Competence				
Knowledge	Students will be able to outline ke as their mutual dependence for relevant economic, environmental explain and outline the organisati able to explain the available wa application.	sustainable water s al and social factor ional structures of w	supply. They will rs. Students will vater companies.	understand be able to They will be
Skills	Students will be able to assess co establish solutions involving wate be able to assess the evaluation n able to carry out chemical calcula generally accepted technical rules	r management and the methods that can be ations for selected tr	technical measur used for this. Stude eatment processe	es. They will dents will be
Personal Competence				
Social Competence	Working in a diverse group of s document complex solutions for t	he management and appropriate profess will be able to devel	l treatment of dri sional position, f	nking water. or example
Autonomy	Students will be in a position to this subject.	work on a subject ir	ndependently and	I present on
Workload in Hours	Independent Study Time 96, Study	/ Time in Lecture 84		
Credit points	6			
Course achievement	INONE			
Examination	Written exam	-		
Examination duration and scale	60 min (chemistry) + presentation	1		
Assignment for	Civil Engineering: Specialisation St Civil Engineering: Specialisation G Civil Engineering: Specialisation W Civil Engineering: Specialisation Co Energy and Environmental Engin	eotechnical Engineer later and Traffic: Con pastal Engineering: E	ring: Elective Com npulsory Elective Compulso	pulsory

the Following	Engineering: Elective Compulsory
Curricula	International Management and Engineering: Specialisation II. Energy and
	Environmental Engineering: Elective Compulsory
	Water and Environmental Engineering: Specialisation Water: Compulsory
	Water and Environmental Engineering: Specialisation Environment: Elective
	Compulsory
	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory

Course L0311: Che	mistry of Drinking Water Treatment
Тур	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
	The topic of this course is water chemistry with respect to drinking water treatment and water distribution
Content	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.
	MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John
	Wiley & Sons, Hoboken, 2005.
	Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley & Sons, New York, 1996.
Literature	<b>DVGW (Hrsg.):</b> Wasseraufbereitung - Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004.
	<b>Jensen, J. N.</b> : A Problem Solving Approach to Aquatic Chemistry. John Wiley & Sons, Inc., New York, 2003.

Course L0312: Chemistry of Drinking Water Treatment		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	2	
<b>Workload in Hours</b>	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 Resource 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 Resource Management		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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		Typ	Hrs/wk CP
Integrated Transportat	ion Planning (L1068)	Project-/problem- based Learning	4 6
Module Responsible	Prof. Carsten Gertz		
Admission Requirements	None		
	some knowledge of transport plan "Transport Planning and Traffic En		the undergraduate clas
Educational Objectives	After taking part successfully, stud	ents have reached the foll	lowing learning results
Professional Competence	Students are able to:		
Knowledge	transportation/mobility beha • explain and evaluate the so	cial, ecological and econo es. he area of integrated t	mic effects of transpo
Skills	<ul> <li>Students are able to:</li> <li>quantify important paraminfluenced by it.</li> <li>comprehensively examine transportation studies perswith scientific conventions.</li> </ul>	a pre-defined or self-s pective and document the	selected topic from
Personal Competence	Students are able to:		
Social Competence	<ul> <li>provide feedback on topical</li> <li>constructively handle feedb</li> <li>produce results in group wo</li> </ul>	ack on their own work.	ng.
Autonomy	Students are able to:  • assess potential consequence  • independently plan working necessary knowledge and undependent	g on a pre-defined proj	ject topic, acquire th
Workload in Hours	Independent Study Time 124, Stud	ly 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 Following Curricula	

Course L1068: Integrated Transportation Planning		
Тур	Project-/problem-based Learning	
Hrs/wk	4	
СР	6	
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Prof. Carsten Gertz, Dr. Philine Gaffron, Jacqueline Bianca Maaß	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>The course will provide students with an understanding of interdependencies between land-use and transportation. Specific topics include a.o.:         <ul> <li>interactions between transport and the environment and consequent limitations</li> <li>characteristics of integrated planning</li> <li>complex planning processes</li> <li>interdependencies of location choice and mobility behaviour</li> <li>transport and land-use policies</li> <li>project on current issues in transportation studies</li> </ul> </li> </ul>	
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	3: Steel and Composite	Structures		
Courses				
Title		Тур	Hrs/wk	СР
Steel and Composite S	tructures (L1204)	Lecture	2 Continu	2
Steel and Composite S	tructures (L1205)	Recitation (large)	Section 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	LATTER TAKING NART SHCCESSTIIIV STI	udents have reached t	he following learr	ning results
Professional Competence <i>Knowledge</i>	After successful completition, stu  describe the phenomenon explain warping torsion	of local buckling		
Skills	<ul> <li>specify the principles in de</li> <li>sketch the contructions of</li> <li>After successful participation stu</li> <li>check stiffened and unstiff</li> </ul>	esign of composite stra steel and composite be dents are able to fened plated structure ing tosion in strucures es	oridges s	
Personal				
Competence				
Social Competence				
Autonomy				
	Independent Study Time 96, Stu	dy Time in Lecture 84		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following Curricula	Civil Engineering: Specialisation Civil Engineering: Specialisation Civil Engineering: Specialisation Civil Engineering: Specialisation International Management and Elective Compulsory	Geotechnical Engineer Coastal Engineering: E Water and Traffic: Elec	ing: Elective Com lective Compulso tive Compulsory	ry

Course L1204: Steel and Composite Structures		
Тур	Lecture	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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 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: Stee	el Bridges
Тур	Lecture
Hrs/wk	2
СР	2
	Independent Study Time 32, Study Time in Lecture 28
	Dr. Jörg Ahlgrimm
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
Content	- 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      Determine Skrightere Absolution Berinden berinden.
	<ul> <li>Petersen, Christian: Stahlbau, Abschnitt Brückenbau</li> <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	9: Selected Topics in Civil I	Engineering		
Courses				
	ructures (L1867) onal Project Delivery (L2387) d Concrete Structures (L0596)	<b>Typ</b> Lecture Integrated Lecture Lecture	<b>Hrs/wk</b> 1 2	<b>CP</b> 1 2 1
	d Concrete Structures (L0597)	Recitation Section	_	1
Forum I - Geotechnics	and Construction Management (L1634) and Construction Management (L1635) ing Design (L2447) .51)	(large) Seminar Seminar Lecture Seminar Lecture	1 1 2 2 2	1 1 3 2 2
Special topics of civil e	ngineering 1CP (L2378) ngineering 2 LP (L2379) ngineering 3 LP (L2380)	Recitation Section (large) Lecture	'1 1 2 3 1	1 1 2 3 1
Module Responsible	Prof. Uwe Starossek			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students	s have reached the follo	wing learr	ning 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	<ul> <li>Students are able to apply bastructural engineering.</li> </ul>	asic methods in selecto	ed areas	of civil and
Personal Competence Social Competence				
Autonomy	<ul> <li>Students can chose independently, in which fields they want to deepen their knowledge and skills through the election of courses.</li> </ul>			
Workload in Hours	Depends on choice of courses			
Credit points				
Assignment for the Following Curricula	Civil Engineering: Specialisation Struct Civil Engineering: Specialisation Geote	chnical Engineering: Ele al Engineering: Elective	ctive Con Compulso	npulsory

Course L1867: Ana	lysis of Offshore Structures
Тур	Lecture
Hrs/wk	1
СР	1
	Independent Study Time 16, Study Time in Lecture 14
<b>Examination Form</b>	
Examination duration and scale	30 min
	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
Content	Topic 5: Linear-Time-Invariant Systems, response of an LTI-system in frequency domain
Content	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
	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
Literature	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
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Examination Form</b>	laut FSPO
Examination duration and scale	wird zu Beginn der Lehrveranstaltung festgelegt
Lecturer	NN
Language	EN
Cycle	SoSe
Content	
Literature	

Course LOEGO Design of Businshipshed Congress Chrystowns		
Course L0596: Design of Prefabricated Concrete Structures  Typ Lecture		
Hrs/wk		
CP		
	Independent Study Time 16, Study Time in Lecture 14	
Examination Form		
Examination duration and 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> <li>Broschüren der Fachvereinigung Deutscher Betonfertigteilbau e.V. siehe: www.fdb-fertigteilbau.de www.systembauweise.de</li> </ul>	

Course L0597: Design of Prefabricated Concrete Structures	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Examination Form</b>	Klausur
Examination duration and scale	Siehe korrespondierende Vorlesung
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			
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14			
<b>Examination Form</b>	Mündliche Prüfung			
Examination duration and scale	30 min			
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			
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14			
<b>Examination Form</b>	Mündliche Prüfung			
Examination duration and 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			
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28			
<b>Examination Form</b>	Schriftliche Ausarbeitung			
Examination duration and scale				
Lecturer	Prof. Jürgen Grabe, 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		
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28		
<b>Examination Form</b>	Referat		
Examination duration and scale	90 min		
Lecturer	Prof. Torsten Faber		
Language	DE		
Cycle	WiSe		
Content			
Literature			

Course L1152: Glass Structures								
Тур	Lecture							
Hrs/wk	2							
СР	2							
	Independent Study Time 32, Study Time in Lecture 28							
<b>Examination Form</b>	Mündliche Prüfung							
Examination duration and scale								
Lecturer	Marvin Matzik							
Language	DE							
Cycle								
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		
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14		
<b>Examination Form</b>	Mündliche Prüfung		
Examination duration and scale			
Lecturer	Marvin Matzik		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Course L2378: Special topics of civil engineering 1CP				
Тур				
Hrs/wk	1			
СР	1			
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14			
<b>Examination Form</b>	laut FSPO			
Examination duration and scale	wird zu Beginn der Lehrveranstaltung festgelegt			
Lecturer	Dozenten des SD B			
Language	DE			
	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			
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28			
<b>Examination Form</b>	laut FSPO			
Examination duration and scale	wird zu Beginn der Lehrveranstaltung festgelegt			
Lecturer	Dozenten des SD B			
Language	DE			
	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			
<b>Workload in Hours</b>	Independent Study Time 48, Study Time in Lecture 42			
<b>Examination Form</b>	laut FSPO			
Examination duration and scale	wird zu Beginn der Lehrveranstaltung festgelegt			
Lecturer	Dozenten des SD B			
Language	DE			
	WiSe/SoSe			
Content	The course occurs only if required. The content is defined at short notice.			
Literature	Die Literatur wird kurzfristig festgelegt.			

Course L1905: Wind turbine design			
Тур	Lecture		
Hrs/wk	1		
СР	1		
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14		
<b>Examination Form</b>	Mündliche Prüfung		
Examination duration and scale	30 min		
Lecturer	Dr. Jörn Scheller		
Language	DE		
Cycle	WiSe		
Content			
Literature			

Module M0966	5: Study Work Foundation Engineering					
Courses						
Title	Typ Hrs/wk CP					
- Nespensione						
Admission Requirements	None					
Recommended Previous Knowledge	Subjects of the Foundation Engineering specialisation.					
Educational Objectives	After taking part successfully, students have reached the following learning results					
Professional Competence						
	The students are able to demonstrate their detailed knowledge in the field of geotechnical and foundation engineering. They can exemplify the state of technology and application and discuss critically in the context of actual problems and general conditions of science and society.					
Knowledge	The students can develop solving strategies and approaches for fundamental and practical problems in geotechnical and foundation engineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic 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						
	The students are able to condense the relevance and the structure of the project work, the work steps and the sub-problems for the presentation and discussion ir front of a bigger group. They can lead the discussion and give a feedback on the project to their colleagues.					
Autonomy	The students are capable of independently planning and documenting the work steps and procedures while considering the given deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedback from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology.					
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0					
Credit points						
Course achievement						
Examination	-					
Examination duration and scale						
Assignment for the Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Compulsory					

Module M0997: Structural Analysis - Selected Topics							
Courses							
Title Plates and Shells (L119)	99) Frame Structure (L1200)		Typ Lecture Lecture		Hrs/wk 2 2	<b>CP</b> 2 2	
Nonlinear Analysis of F	rame Structure (L1201)		Recitation (large)	Section	2	2	
Module Responsible	Prof. Uwe Starossek						
Admission Requirements	None						
Recommended Previous Knowledge		II, Differentia	al Equations	I			
Educational Objectives	After taking part successfully,	After taking part successfully, students have reached the following learning results					
Professional Competence	After successful completion of this module, students can explain selected elements of higher structural analysis.						
Knowledge Skills	After successful completion of premises and the applicability analysis. They are able to use	ty of the pr	resented me	ethods of	· advance	d structural	
Personal Competence							
Social Competence	Students can  • participate in subject-specific and interdisciplinary discussions,						
Autonomy	The students have the opport problems.	unity to volu	ıntarily and i	ndepend	ently wor	k homework	
Workload in Hours	Independent Study Time 96, S	Study Time i	n Lecture 84				
Credit points	6						
Course achievement	None						
Examination Examination duration and scale							
the Following	Civil Engineering: Specialisation Civil Engineering: Specialisation Civil Engineering: Specialisation	on Geotechr	nical Enginee	ring: Elec	ctive Com	pulsory	

Course L1199: Plat	es and Shells					
Тур	Lecture					
Hrs/wk						
СР	2					
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28					
Lecturer	Dr. Jürgen Priebe					
Language	DE					
Cycle	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> <li>Zienkiewicz, O.C. (1977): The Finite Element Method in Enginieering Science. McGraw-Hill, London</li> </ul>					

Course L1200: Non	linear Analysis of Frame Structure					
Тур	Lecture					
Hrs/wk	2					
СР	2					
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28					
Lecturer	Prof. Uwe Starossek					
Language	DE					
Cycle	WiSe					
	-Types of nonlinearity					
	-relevance of nonlinear effects on structural analysis					
	-comparison and classification of 1 $^{\rm st}$ order theory, 2 $^{\rm nd}$ order theory and 3 $^{\rm rd}$ order theory with regard to the coverage of geometric nonlinearity					
	-fundamentals of 2 <sup>nd</sup> order elasticity theory for frame structures					
Content	-application of 2 <sup>nd</sup> order elasticity theory using finite elements: common displacement method					
Content	-fundamentals of analytical application of 2 $^{\rm nd}$ 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					
	Rothert, H.; Gensichen, V. (1987): Nichtlineare Stabstatik. Springer Verlag, Berlin					
Literature						

Course L1201: Nonlinear Analysis of Frame Structure		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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	

Module M15 Engineering ( <i>I</i>	05: Adaptation to Climate Change in Hydraulic AKWAS)						
Courses							
Title	Typ Hrs/wk CP						
Adaptation to climate	e change in hydraulic engineering (L2291)  Project-/problem- based Learning  6						
Module Responsible							
Admission Requirements	None						
Recommended Previous Knowledge	<ul> <li>Hydrology, Hydraulic Engineering</li> <li>Hydromechanic, Hydraulics</li> <li>Fundamentals of Coastal Engineering, Coastal- and Flood Protection</li> <li>Hydrological Systems</li> </ul>						
Educational Objectives	After taking part successfully, students have reached the following learning results						
Professional Competence							
Knowledge	<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>						
Skills	<ul> <li>Critical thinking: analysis of processes and relations, assessment of needs for action</li> <li>Creative thinking: development of adaptation strategies and adaptation measures</li> <li>Practical thinking: inclusion of restrictions, application of calculation approaches, methods, numerical models, planning methods</li> <li>Consideration of complex tasks</li> </ul>						
Personal Competence							
Social Competence	<ul> <li>Working in heterogenous groups</li> <li>Working with different scientific / non-scientific disciplines</li> <li>Self reflection</li> </ul>						
Autonomy	<ul> <li>Application oriented use of knowledge and skills</li> <li>Autonomous work on complex tasks</li> </ul>						
	Independent Study Time 124, Study Time in Lecture 56						
Credit points							
Course achievement	None						
Examination	Written elaboration						

Examination duration and scale	Preparation of a written report and a presentation of a complex task.
Assignment for the Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Water and Environmental Engineering: Specialisation Cities: Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Elective Compulsory 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				
<b>Workload in Hours</b>	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 Structural Engineering

Module M0699	9: Geotechnics III				
Courses					
<b>Title</b> Numerical Methods in Geotechnics (L0375) Advanced Foundation Engineering (L0497) Advanced Foundation Engineering (L0498)			<b>Typ</b> Lecture Lecture Recitation (large)	Hrs/wk 3 2 Section 1	<b>CP</b> 3 2
Module Responsible	Prof. Jurgen Grabe				
Admission Requirements	LNIONA				
Recommended Previous Knowledge					
Educational Objectives		ully, students ha	ave reached	the following learr	ning results
Professional Competence					
Knowledge Skills	<u> </u>				
Personal Competence Social Competence Autonomy					
Workload in Hours	Independent Study Time 9	96, Study Time i	n Lecture 84	ļ	
Credit points	6				
Course achievement	Yes None S	<b>orm</b> ubject theore ractical work		Description	
Examination	Written exam				
Examination duration and scale	120 min				
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Compulsory 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			
<b>Workload in Hours</b>	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: Adv	anced Foundation Engineering					
Тур	Lecture					
Hrs/wk						
СР	2					
<b>Workload in Hours</b>	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	Typ Recitation Section (large)				
Hrs/wk	1				
СР	1				
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14				
Lecturer	Prof. Jürgen Grabe				
Language	DE				
Cycle	WiSe				
Content	See interlocking course				
Literature	See interlocking course				

Module M0713	3: C	oncrete St	ruct	tures					
Courses									
Title					Тур		Hrs/wk	, (	
Concrete Structures (L	.0579)	)			Seminar		1		L
Structural Concrete Me	ember	rs (L0577)			Lecture		2	3	3
Structural Concrete Me	ember	rs (L0578)			Recitation (large)	Section	2	2	2
Module Responsible	IPIOI	. Günter Rombac	ch						
Admission Requirements	None	е							
-	Basi	cs of structural a	analy	sis, conception a	and dimens	ioning of s	tructura	l co	ncrete
Recommended Previous Knowledge		ules: Reinforced	l Cond	crete Structures	I+II, Struct	ural Analy:	sis I+II,	Мес	hanics I+I
Educational Objectives	ΙΔΤΓΔΙ	r taking part suc	ccessf	fully, students h	ave reached	d the follo	wing lea	rnin	g results
Professional	<u> </u>								
Competence	:								
Knowledge	build	students broade dings (houses, ro design of concre	oofs,	halls). They dis	spose of the	e knowled	ge for t	he c	onception
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	ļ								
Social Competence	The	students are abl	le to	obtain results of	high qualit	y in teamv	vork.		
Autonomy		students are ab			plex concep	otion and	dimensi	onin	g tasks of
	<u> </u>								
Workload in Hours	!	pendent Study I	Time	110, Study Time	e in Lecture	70			
Credit points	Con	npulsor <b>B</b> onus		orm		Descripti	on		
Course achievement		None		resentation		<b>Descript</b> i Es wer ausgegeb	den	2	Referate
Examination	l Writi	 ten exam				dubgeges	CII		
Examination duration and scale	120								
Assignment for the Following Curricula	Civil Civil Civil Inter	Engineering: Sp Engineering: Sp Engineering: Sp Engineering: Sp rnational Manag tive Compulsory	pecial pecial pecial geme	isation Geotech isation Coastal I isation Water ar	nical Engine Engineering nd Traffic: E	eering: Ele : Elective lective Co	ctive Co Compuls mpulsor	sory y	-

Course L0579: Concrete Structures				
Тур	Seminar			
Hrs/wk	1			
СР	1			
<b>Workload in Hours</b>	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 L0577: Stru	ictural Concrete Members
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
	Prof. Günter Rombach
Language	
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>
Literature	<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,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 Concrete Members					
Тур	Typ 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	3: Steel and Compos	ite Stru	ctures			
Courses						
<b>Title</b> Steel and Composite S	tructures (L1204)		<b>Typ</b> Lecture		Hrs/wk 2	<b>CP</b> 2
Steel and Composite S	tructures (L1205)		Recitation (large)	Section	12	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 Str	uctures I and	l II, BUBC	<b>(</b> )	
Educational Objectives	After taking part successfully,	students h	ave reached	the follo	wing learn	ing results
Professional Competence	After successful completition,	students ca	an			
Knowledge	<ul> <li>describe the phenomer</li> <li>explain warping torsion</li> <li>illustrate the behaviour</li> <li>specify the principles ir</li> <li>sketch the contructions</li> </ul>	of compos design of o	ite structures composite st	tructures		
Skills	After successful participation students are able to  check stiffened and unstiffened plated structures recognize and verify warping tosion in strucures design composite structures design bridges and o perform the detailing					
Personal						
Competence						
Social Competence Autonomy						
-	Independent Study Time 96, S	Study Time	in Lecture 84	ļ		
Credit points	· · · · · · · · · · · · · · · · · · ·					
Course achievement	None					
Examination	Written exam					
Examination duration and scale						
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory					

Course L1204: Steel and Composite Structures				
Тур	Lecture			
Hrs/wk	2			
СР	2			
<b>Workload in Hours</b>	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 Composite Structures			
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	2		
<b>Workload in Hours</b>	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: Stee	el Bridges
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Jörg Ahlgrimm
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
Content	- 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. 114</li> </ul>

Module M051	L: Electricity Generation	on from Wind an	d Hydro Po	wer	
Courses					
<b>Title</b> Sustainability Manager Hydro Power Use (L003) Wind Turbine Plants (L Wind Energy Use - Foc	13) 0011)	<b>Typ</b> Lecture Lecture Lecture Lecture Lecture	Hrs/wk 2 1 2 1	CP 1 1 3 1	
Module Responsible	Dr. Isabel Höfer				
Admission Requirements	None				
Recommended Previous Knowledge	Module: Technical Thermodynar	nics II,			
Educational Objectives	After taking part successfully, st	udents have reached th	e following learn	ing results	
Professional Competence		s can explain in detail	knowledge of w	ind turhines	
Knowledge	By ending this module students can explain in detail knowledge of wind turbines with a particular focus of wind energy use in offshore conditions and can critical comment these aspects in consideration of current developments. Furthermore, they are able to describe fundamentally the use of water power to generate electricity. The students reproduce and explain the basic procedure 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 the application of the theoretical background and are thus able to transfer what they have learned in practice.				
Skills	Students are able to apply the acquired theoretical foundations on exemplary water or wind power systems and evaluate and assess technically the resulting relationships in the context of dimensioning and operation of these energy systems. They can in 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 sources in the context of the emphasis of the lecture material to clear the contents of the lecture and to acquire the particular knowledge about the subject area.				
Workload in Hours	Independent Study Time 96, Stu	idy Time in Lecture 84			
Credit points					
Course achievement	None				
Examination	Written exam				
Examination duration and scale	2.5 hours written exam + Prens	entation in sustainability	/ management		

Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Energy and Environmental Engineering: Specialisation Energy Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Renewable Energy: **Elective Compulsory** International Management and Engineering: Specialisation II. Energy and Environmental Engineering: Elective Compulsory Product Development, Materials and Production: Specialisation **Product** Assignment for Development: Elective Compulsory the Following Product Development, Materials and Production: Specialisation Production: Elective Curricula Compulsory Product Development, Materials and Production: Specialisation Materials: Elective Compulsory Renewable Energies: Core qualification: Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory Theoretical Mechanical Engineering: Specialisation Energy Systems: Elective Compulsory Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Compulsory Water and Environmental Engineering: Specialisation Cities: Elective Compulsory

Course L0007: Sust	tainability Management					
Тур	Lecture					
Hrs/wk	2					
СР						
<b>Workload in Hours</b>	Independent Study Time 2, Study Time in Lecture 28					
Lecturer	Dr. Anne Rödl					
Language	DE					
Cycle	WiSe					
	The lecture sustainability management provide an insight into the various aspects and dimensions of sustainability. This content of the course is based on the foundations of environmental assessment; therefore the previous attendance of the lecture environmental assessment is recommended. Various valuation approaches for assessing environmental, economic and social aspects are presented. Their application and use for a sustainability management's discussion is explained by means of short technology examples and is later comprehensively presented through case examples.  • Introduction to the topic of sustainability • Dimensions of sustainability:  • ecology  • economics  • social  • Transition from the environmental assessment for sustainability management  • Case Studies  • Excursion  Objective: The aim of the course is to learn methods for the assessment of sustainability aspects and apply for sustainability management.					
Literature	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: Hyd	ro Power Use				
Тур	Lecture				
Hrs/wk	1				
СР	1				
<b>Workload in Hours</b>	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: Win	d Turbine Plants				
Тур	Lecture				
Hrs/wk	2				
СР	3				
<b>Workload in Hours</b>	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					
<b>Workload in Hours</b>	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, Heidelberg, 1997, 3. Auflage</li> <li>Hau, E.: Windkraftanalagen; 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>					

Module M1351	L: Construction Pro	ocesses		
Courses				
<b>Title</b> Digital Building (L1908) Lean Construction (L1910) System Dynamics (L1909)		<b>Typ</b> Lecture Lecture Lecture	Hrs/wk 2 2 2	<b>CP</b> 2 2 2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfu	ully, students have reached the	following learn	ing results
Professional Competence				
Knowledge Skills				
Personal Competence Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 9	96, Study Time in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	60 min			
Assignment for the Following Curricula	Civil Engineering: Specialis Civil Engineering: Specialis	sation Coastal Engineering: Elec sation Geotechnical Engineering sation Structural Engineering: E sation Water and Traffic: Electiv	g: Elective Com lective Compul	pulsory

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

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

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

Module M072 Bridges	23: Design of Prestressed Structures and Concrete				
Courses					
	Typ Hrs/wk CP  Structures and Concreet Bridges (L0603) Lecture 3 4  Structures and Concreet Bridges (L0604) Recitation (large) 2 2				
Module Responsible	Prof. Günter Rombach				
Admission Requirements	None				
	Detailed knowledge on the design of concrete structures.  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 types, their applications and the various loads. They can explain the basic design methods. They can explain the design of a prestressed bridge.				
Skills	The students are able to design reinforced or prestressed concrete bridges.				
Personal Competence Social Competence	The students can design in teamwork a real concrete bridge.				
·	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	6				
Course achievement	None				
Examination	Written exam				
Examination duration and scale					
the Following	Civil Engineering: Specialisation Structural Engineering: Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory				

Course L0603: Des	ign of Prestressed Structures and Concreet Bridges				
Тур	Lecture				
Hrs/wk	3				
СР	4				
<b>Workload in Hours</b>	Independent Study Time 78, Study Time in Lecture 42				
Lecturer	rof. Günter Rombach				
Language	DE				
Cycle	SoSe				
Content	<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>				
	<ul> <li>history of bridges</li> <li>design of 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 Prestressed Structures and Concreet Bridges					
Тур	Typ Recitation Section (large)				
Hrs/wk	rs/wk 2				
СР	2				
<b>Workload in Hours</b>	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	6: Soil Mechanic	s and -Dynar	mics		
Courses					
Title Soil Mechanics - Select Soil Dynamics (L0452)			<b>Typ</b> Lecture Lecture Practical Course	Hrs/wk 2 3 1	<b>CP</b> 2 2 2
Module	· •	0)	Fractical Course	т	
Responsible Admission	Prof. Jurgen Grabe				
Requirements	none				
Recommended Previous Knowledge	I COLITEGE: SOIL LABORATOR			s)	
Educational Objectives	     After taking part succe	essfully, students ha	ave reached the fo	llowing learn	ing results
Professional Competence					
Knowledge	to derive and to     to understand to     to detect the re     to know the escharacteristics a     to design machi     to measure show     to evaluate show     to evaluate poss     to understand not in term of their     to know method bedding modulu     to know the module consider the understand not in term of their     to design modulu     to distinguish to the strength.	<ul> <li>to capture the visous behaviour of cohesive soils and to consider the effects of creep and rate-dependent shear strength in calculations,</li> <li>to consider the impact of the partly saturated of a seepage and shear</li> </ul>			
Personal Competence	<u>'</u>				
Social Competence	i				
Autonomy					
	Independent Study Tin	ne 96, Study Time i	n Lecture 84		
Credit points	i				
Course achievement	CompulsorBonus Form Description  Yes 15 % Subject theoretical and practical work				
Examination	Written exam				
Examination					

duration and scale	
Assignment for	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
the Following	Civil Engineering: Specialisation Geotechnical Engineering: Compulsory
Curricula	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory

Course L0374: Soil	Mechanics - Selected Topics
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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		
СР			
<b>Workload in Hours</b>	Independent Study Time 18, Study Time in Lecture 42		
Lecturer	Alexander Chmelnizkij		
Language			
Cycle	SoSe		
	mass-spring-damper systems,		
	wave propagation in soils,		
	dynamic soil parameters,		
	Determination of dynamic soil parameters,		
	machine foundations,		
Content	• 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: Exp	erimental Researches in Geotechnics		
Тур	Practical Course		
Hrs/wk	1		
СР	2		
<b>Workload in Hours</b>	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Marius Milatz		
Language	DE		
Cycle	SoSe		
Content	<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> <li>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.</li> <li>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.</li> </ul>		
Literature	<ul> <li>Grabe, J. (2004): Bodenmechanik und Grundbau, Band 3 der Veröffentlichungsreihe des Instituts für Geotechnik und Baubetrieb, Technische Universität Hamburg-Harburg.</li> <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 - Eindimensionaler Kompressionsversuch, Deutsches Institut für Normung, e. V.</li> <li>DIN 18137-2:2011-04: Baugrund, Untersuchung von Bodenproben - Bestimmung der Scherfestigkeit - Teil 2: Triaxialversuch, Deutsches Institut für Normung e. V.</li> </ul> </li> </ul>		

Module M0807	7: Boundary Elemo	ent Method	ls		
Courses					
<b>Title</b> Boundary Element Met Boundary Element Met			<b>Typ</b> Lecture Recitation (large)	Hrs/wk 2 Section 2	<b>CP</b> 3
Module	Prof. Otto von Estorff		(large)		
Responsible					
Admission Requirements	None				
Recommended Previous Knowledge	Mechanics I (Statics, M Kinematics, Dynamics) Mathematics I, II, III (in pa				lydrostatics,
Educational Objectives	After taking part successf	fully, students ha	ave reached th	ne following learn	ing results
Professional					
Competence  Knowledge	The students possess a boundary element methodical basis of the m	d and are able			
Skills	The students are capable boundary elements, asse resulting system of equat	mbling the corre			
Personal Competence Social Competence	Students can work in sma		·	•	
Autonomy	The students are able to and develop own boundaresults are critically scrut	ary element rou			
Workload in Hours		124. Study Time	in Lecture 56		
Credit points	,	, <b>j</b>	2223.000		
Course achievement	1 7	orm Iidterm	De	escription	
Examination	-				
Examination duration and scale					
	Civil Engineering: Special Civil Engineering: Special Civil Engineering: Special Energy Systems: Core qu	isation Geotechr isation Coastal E	nical Engineer Engineering: E	ing: Elective Com lective Compulsor	pulsory

Assignment for	Mechanical Engineering and Management: Specialisation Product Development and Production: Elective Compulsory
the Following	Mechatronics: Specialisation System Design: Elective Compulsory Product Development, Materials and Production: Core qualification: Elective
Curricula	Compulsory
	Technomathematics: Specialisation III. Engineering Science: Elective Compulsory Theoretical Mechanical Engineering: Technical Complementary Course: Elective
	Compulsory
	Theoretical Mechanical Engineering: Specialisation Simulation Technology: Elective Compulsory

Course L0523: Boundary Element Methods			
Тур	Lecture		
Hrs/wk			
СР	3		
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Otto von Estorff		
Language	EN		
Cycle	SoSe		
Content	<ul> <li>Boundary value problems</li> <li>Integral equations</li> <li>Fundamental Solutions</li> <li>Element formulations</li> <li>Numerical integration</li> <li>Solving systems of equations (statics, dynamics)</li> <li>Special BEM formulations</li> <li>Coupling of FEM and BEM</li> <li>Hands-on Sessions (programming of BE routines)</li> <li>Applications</li> </ul>		
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 Element Methods		
Тур	Recitation Section (large)	
Hrs/wk	2	
СР	3	
<b>Workload in Hours</b>	ndependent 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	

Module M0827	7: Modeling in Water Mana	gement		
Courses				
Title	using Modflow (L0543)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b>
_	using Modflow (L0544)	Recitation Section (small)	-	2
Modeling of Water Sup	ply and Sewer Network (L0875)	Project-/problem- based Learning	2	3
Admission Requirements	None			
	Groundwater			
	<ul> <li>groundwater hydraulics and trar</li> </ul>	nsport of substances		
Recommended	Pipe Systems			
Previous Knowledge				
Educational Objectives	After taking part successfully, students	have reached the follo	owing learn	ing results
Professional Competence				
·	The students are able to describe the modelling of groundwater flow and transport as well as urban water infrastructures. They can carry out systems analyses and can detect technical and conceptual weak points within the systems in case studies. Besides they are able to analyse interdependencies of hydraulic and toxic phenomena in soil and water.			
Skills	The students are able to construct and apply scientific groundwater models indipendently. They can work on different scenarios and can compare or assess different solutions for existing problems by application of selected software products. The students are able to use different software solutions (e.g. EPANET, EPA-SWMM).			
Personal Competence				
Social Competence	Wird nicht vermittelt.			
Autonomy	Wird nicht vermittelt.			
	Independent Study Time 110, Study Ti	me in Lecture 70		
Credit points				
Course achievement				
Examination				
Examination duration and scale	20 min			



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

Course L0544: Groundwater Modeling using Modflow		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Sonja Götz (geb. Schröter)	
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		
<b>Workload in Hours</b>	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 M0828	8: Urban Environmen	ıtal Manage	ement		
Courses					
Title Noise Protection (L110		<b>Typ</b> Lect Proie		Hrs/wk	<b>CP</b> 2
Urban Infrastructures (	(L0874)		ed Learning	2	4
Module Responsible	TOE DOPOTORA RECOTENDACO				
Admission Requirements	LNODE				
Recommended Previous Knowledge	Knowledge on measure	es for climate pro			
Educational Objectives	I ATTOR TAKING NART CHICCOCCIIIIIV	students have r	reached the follo	owing learn	ing results
Professional Competence					
-	Students can describe urban development corridors as well as current and future urban environmental problems. They are able to 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 urban life. They can, for example, derive and discuss measures for effective noise abatement.				
Skills	Students are able to develop specific solutions for correcting existing or future environment-related problems of urban development. They can define a range of conceptual and technical solutions for environmental problems for different development paths. To solve specific urban environmental problems they can select technical innovations and integrate them into the urban context.				
Personal					
Competence Social Competence	The students can work togeth	er in internation	al groups.		
Autonomy	Students are able to organize their work flow to prepare themselves for presentations and contributions to the discussions. They can acquire appropriate knowledge by making enquiries independently.				
Workload in Hours	Independent Study Time 124,	Study Time in L	ecture 56		
Credit points	6				
Course achievement	LNODE				
	Written elaboration				
Examination duration and scale	Written Report plus oral Prese	entation			
Assignment for the Following Curricula	qualification: Compulsory	on Geotechnical on Coastal Engir on Water and Tra ore qualification vironmental Stu Mobility: Speci	Engineering: Eleneering: Elective affic: Elective Compidies - Cities and alisation Infras	ective Com Compulsory ompulsory ulsory nd Sustaina tructure ar	pulsory Ty ability: Core and Mobility:

Compulsory Water and Environmental Engineering: Specialisation Cities: Compulsory

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

Course L0874: Urban Infrastructures		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
СР	4	
<b>Workload in Hours</b>	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.	

Module M0859	9: Coastal Hydraulic Engine	ering II		
Courses				
<b>Title</b> Coastal- and Flood Pro	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3	
Coastal- and Flood Pro	tection (L1415)	Project-/problem- based Learning	1	1
Maintennance and Def	ence of Flood Protection Structures (L1411)	Lecture	2	2
- Respensione	Prof. Peter Fröhle			
Admission Requirements	None			
Knowledge	Coastal Engineering I			
Educational Objectives	After taking part successfully, students h	ave reached the foll	owing learn	ing results
Professional Competence				
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 important coastal protection measures from the functional and from the constructional point of view.			
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 gai the functional and constructive design Additionaly, they will be able to work in t	of coastal and floor	d protection	structures.
Autonomy	The students will be able to independently extend their knowledge and apply it to new problems.			
	Independent Study Time 110, Study Tim	e in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	The duration of the examination is 130 respect to the general understanding of			
the Following	Civil Engineering: Specialisation Structur Civil Engineering: Specialisation Geotech Civil Engineering: Specialisation Coastal	nical Engineering: E	lective Com	

Course L0808: Coa	stal- and Flood Protection
Тур	Lecture
Hrs/wk	2
СР	3
<b>Workload in Hours</b>	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  Technical solution for the protection of sandy coasts  Construction in direction of the coast  Constructions perpendicular to the coast  Other Concepst  Calculation approaches and numerical models  Flood Protection  Classification of constructions / measures  Dikes  Dunes  Foreland - constructions  Flood-Protection Walls  Drainage of the hinterland
Literature	Vorlesungsumdruck Coastal Engineering Manual CEM

Course L1415: Coastal- and Flood Protection		
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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	
<b>Workload in Hours</b>	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	

Module M0860	D: Harbour Engineering a	nd Harbour Plan	ning	
Courses				
<b>Title</b> Harbour Engineering (I	L0809)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 2
Harbour Engineering (I	L1414)	Project-/problem- based Learning	1	2
Port Planning and Port	Construction (L0378)	Lecture	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous Knowledge	Basics of coastal engineering			
Educational Objectives	After taking part successfully, studer	nts have reached the fol	lowing learn	ing results
Professional Competence				
Knowledge	The students are able to define in details and to choose design approaches for the			
Skills	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 the functional design of ports. Additengineers of other disciplines.			
Autonomy	The students will be able to independently extend their knowledge and apply it to new problems.			
<b>Workload in Hours</b>	Independent Study Time 110, Study	Time in Lecture 70		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale	The duration of the examination is 150 min. The examination includes tasks with respect to the general understanding of the lecture contents and calculations tasks.			
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective 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 Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory			

Course L0809: Harbour Engineering		
Тур	Lecture	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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 Engineering		
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	2	
<b>Workload in Hours</b>	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Peter Fröhle	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0378: Port Planning and Port Construction		
Тур	Lecture	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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	

Module M0861	L: Modelling of Hydraulic	Engineering		
Courses				
Title		Тур	Hrs/wk	СР
Hydraulic Models (L08:	13)	Project-/problem- based Learning	1	1
Modelling of Waves (L0	)812)	Project-/problem- based Learning	1	1
Modelling of Flow in Ri	vers and Estuaries (L0810)	Lecture	3	4
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Coastal Hydraulic Engineering I			
Educational Objectives	After taking part successfully, studen	ts have reached the fol	lowing learn	ing 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 flows and waves.			
Skills	Students are able to apply hydrodynamic-numerical models to practical hydraulic engineering tasks.			
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in simple applied problems. Additionaly, they will be able to work in team with others.			
Autonomy	The students will be able to independently extend their knowledge and apply it to new problems.			
<b>Workload in Hours</b>	Independent Study Time 110, Study	Γime in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	The duration of the examination is respect to the general understanding			
the Following	Civil Engineering: Specialisation Struc Civil Engineering: Specialisation Geot Civil Engineering: Specialisation Coas	echnical Engineering: E	lective Com	pulsory

Course L0813: Hydraulic Models		
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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>	
Literature	Strobl, Zunic: Wasserbau, Kap. 11 Hydraulische Modelle, Springer	

Course L0812: Modelling of Waves		
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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 Flow in Rivers and Estuaries		
Тур	Lecture	
Hrs/wk	3	
СР	4	
<b>Workload in Hours</b>	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Dr. Edgar Nehlsen, Prof. Peter Fröhle	
Language		
Cycle	SoSe	
	Basics of numerial models / application of models  classification of models  model concept  modelling	
Content	1D Working Equation  Mathematical description of physical processes  • Equation of motions • • conservation of mass • conservation of momentum • Initial conditions and boundary conditions  Numerical Methods  • Time step procedure • Finite differences • Finite volumes	
Literature	Vorlesungsskript	

Module M0874	1: Wastewater Systems			
Courses				
<b>Title</b> Wastewater Systems -	Collection, Treatment and Reuse (L0934)	<b>Typ</b> Lecture Recitation	Hrs/wk 2	<b>CP</b> 2
Wastewater Systems -	Collection, Treatment and Reuse (L0943)	(large)	Section 1	1
Advanced Wastewater		Lecture Recitation	2 Section <sub>1</sub>	2
Advanced Wastewater	Treatment (L0358)	(large)	1	1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
	Knowledge of wastewater managem wastewater treatment.	ent and the	key processes	involved in
Educational Objectives	After taking part successfully, students	have reached t	he following learr	ning results
Professional Competence				
Knowledge	Students are able to outline key area waste water management, as well as water protection. They can describe refactors.	s their mutual	dependence for	sustainable
Skills	Students are able to pre-design and explain the available wastewater treatment processes and the scope of their application in municipal and for some industrial treatment plants.			
Personal Competence				
Social Competence	Social skills are not targeted in this mod	dule.		
Autonomy	Students are in a position to work on independently. They can also present o		I to organize the	ir work flow
Workload in Hours	Independent Study Time 96, Study Time	e in Lecture 84		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following Curricula	Civil Engineering: Specialisation Structure Civil Engineering: Specialisation Geotec Civil Engineering: Specialisation Coasta Civil Engineering: Specialisation Water & Bioprocess Engineering: Specialisation Compulsory Energy and Environmental Engineering Elective Compulsory Environmental Engineering: Specialisation International Management and Engineering: Elective Colliternational Management and Engineering: Blective Colliternational Management and Engineering Elective Colliternational Management Elective Compulsory Elective Compulsory	chnical Engineer I Engineering: E and Traffic: Cor A - General Bio g: Specialisation ion Water: Elect gineering: Spe mpulsory ering: Specialis	ring: Elective Com Elective Compulso npulsory process Engineer n Environmental tive Compulsory ecialisation II. I	npulsory ory ring: Elective Engineering Energy and

Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory
Process Engineering: Specialisation Process Engineering: Elective Compulsory
Water and Environmental Engineering: Specialisation Water: Compulsory
Water and Environmental Engineering: Specialisation Environment: Elective Compulsory
Water and Environmental Engineering: Specialisation Cities: Compulsory

Course L0934: Wastewater Systems - Collection, Treatment and Reuse		
Тур	Lecture	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Ralf Otterpohl	
Language	EN	
Cycle	SoSe	
Content	<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: Adv	anced Wastewater Treatment
Тур	Lecture
Hrs/wk	2
СР	2
	Independent Study Time 32, Study Time in Lecture 28
	Dr. Joachim Behrendt
Language	
Cycle	
	Survey on advanced wastewater treatment
	reuse of reclaimed municipal wastewater
	Precipitation
	Flocculation
	Depth filtration
Content	Membrane Processes
	Activated carbon adsorption
	Ozonation
	"Advanced Oxidation Processes"
	Disinfection
	Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003
	Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987
Literature	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	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Joachim Behrendt	
Language	EN	
Cycle		
	Aggregate organic compounds (sum parameters)	
	Industrial wastewater	
	Processes for industrial wastewater treatment	
	Precipitation	
Content	Flocculation	
	Activated carbon adsorption	
	Recalcitrant organic compounds	
	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 City Planning (L1066)		<b>Typ</b> Project-/problem-	Hrs/wk	<b>CP</b>
City Planning (L1000)		based Learning	4	0
Module Responsible	Prof. Carsten Gertz			
Admission Requirements	None			
	for "Principles of Urban Planning": no	one		
Previous	for "Designing Urban Streetscapes through taking the undergradua Engineering"			
Educational Objectives	After taking part successfully, stude	nts have reached the foll	owing learn	ing results
Professional				
Competence	Students are able to:			
Knowledge	<ul> <li>use technical terms of urban  </li> <li>describe the main determinar</li> <li>explain and compare differen influenced.</li> <li>discuss requirements for publ</li> <li>explain the importance of street</li> </ul>	nts of urban development t possibilities of how urb ic streetscapes.		ment can b
Skills	Students are able to:  • read and analyze urban devel • appraise such concepts in the • design, justify and reflect the	context of competing re	quirements	
Personal Competence	Students are able to:			
Social Competence	<ul> <li>discuss intermediate results v</li> <li>constructively accept feedback</li> <li>provide constructive feedback</li> </ul>	k on their own work.		
Autonomy	<ul> <li>Students are able to:</li> <li>independently complete a value broadly pre-defined process.</li> <li>assess the consequences of the independently acquire knowle areas.</li> </ul>	neir proposed solutions.		
Morkland in Hours	Independent Study Time 124, Study	Time in Leature E6		

Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	written assignment, designwork during the semester
Assignment for the Following Curricula	Logistics, intrastructure and Mobility: Specialisation intrastructure and Mobility:

Course L1066: City Planning		
	Project-/problem-based Learning	
Hrs/wk		
СР		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
	Prof. Carsten Gertz	
Language	DE	
Cycle		
Content	"Principles of Urban Planning" deals with the determinants of urban development and their interactions. Topics include:  • legal framework, • instruments and methods of planning, • functional requirements, • stakeholders and actors • basic design requirements • different planning levels and • historical contexts.  The objective of the course is for students to acquire a basic understanding of urban development problems and approaches for solving them. They will also be able to comprehend the process of urban planning. The course also covers the various functional and aesthetic requirements for designing streetscape as the most important elements of public space.  The project work deals with a real life scenario and includes drawing up a development plan, an urban design concept, a building masterplan and a street redesign.	
Literature	Albers, Gerd; Wekel, Julian (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.	

Module M0977	7: Construction Logistic	s and Project I	Manageme	ent
Courses				
<b>Title</b> Construction Logistics	(L1163)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 2
Construction Logistics	(L1164)	Recitation (small)	Section 1	2
Project Development a	nd Management (L1161)	Lecture	1	1
Project Development a	nd Management (L1162)	Project-/proble based Learning		1
Module Responsible	Prof. Heike Flämig			
Admission Requirements	None			
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, stud	dents have reached th	ne following lea	rning results
Professional Competence	Students can			
Knowledge	give definitions of the main terms of construction logistics and project development and management			
Skills	<ul> <li>carry out project life cycle a</li> <li>apply methods and instrum</li> <li>apply methods and instrum</li> <li>apply methods and instrum</li> <li>apply methods and instrum</li> <li>design supply and waste re</li> </ul>	ents of construction le ents of project develo ents of conflict mana	opment and ma gement	_
Personal Competence	Students can			
Social Competence			work and case s	tudies
Autonomy	<ul> <li>solve problems by holistic,</li> <li>improve their creativity, no by applying methods of mo</li> </ul>	egotiation skills, conf	lict and crises	solution skills
Workload in Hours	Independent Study Time 124, Stud	dy Time in Lecture 56		
Credit points	6			
Course achievement	None			
	Written elaboration			
Examination duration and	Two written papers with presentat	ions		

scale	
Assignment for the Following Curricula	

Course L1163: Con	struction 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:
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: Con	Course L1164: Construction Logistics	
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
<b>Workload in Hours</b>	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: Proj	ect Development and Management
Тур	Lecture
Hrs/wk	1
СР	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei
Language	DE
Cycle	SoSe
Content	Within the lecture, the main aspects of project development and management are tought:  • Terms and definitions of project management • Advantages and disadvantages of different ways of project handling • organization, information, coordination and documentation • cost and fincance management in projects • time- and capacity management in projects • specific methods and instruments for successful team work  Contents of the lecture are deepened in special exercises.
Literature	Projektmanagement-Fachmann. Band 1 und Band 2. RKW-Verlag, Eschborn, 2004.

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

Module M0998	8: Statics and Dynamics	of Structure	S	
Courses				
Title		Тур	Hrs/wk	СР
Structural Dynamics (L	_1202)	Lecture	2	2
Structural Dynamics (L	_1203)	Recitation	Section 2	2
Fracture mechanics ar	nd fatigue in steel structures (L0564)	(large) Lecture	1	1
Fracture Mechanics an		Recitation (large)	Section 1	1
Module Responsible	I Drot I IMA Staroccav			
Admission Requirements	None			
Recommended	Knowledge of linear structural anal structures; Mechanics I/II, Mathema			determinat
Educational Objectives	After taking part successfully, stude	ents have reached	the following learr	ing results
Professional Competence				
competence	After successful completion of th aspects of dynamic effects on struc			n the bas
Knowledge				
Skills	After successful completion of this response of material and structur computational approaches and met	res to dynamics		
Personal Competence	Students can			
Social Competence	<ul> <li>participate in subject-specific</li> <li>defend their own work results</li> <li>promote the scientific develo</li> <li>Furthermore, they can give a</li> </ul>	s in front of others pment of colleagu	es	criticism
Autonomy	Students are able to gain knowle sources and apply it to new proble solution process for problems in the	ms. Furthermore,	they are able to s	
Workload in Hours	Independent Study Time 96, Study	Time in Lecture 84	ļ	
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	150 min			
	Civil Engineering: Specialisation Str	uctural Engineerin	g: Compulsory	

Assignment for the Following Curricula

Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory
Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
Civil Engineering: Specialisation Water and Traffic: Elective Compulsory
International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory

Course L1202: Structural Dynamics		
Тур	Lecture	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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
<b>Workload in Hours</b>	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

Course L0564: Fracture mechanics and fatigue in steel structures	
Typ Lecture	
Hrs/wk	1
СР	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Ingo Hadrych

Language	DE
Cycle	SoSe
	<ul> <li>basics of fatigue stress and fatigue resistance and determination of fatigue strength,</li> </ul>
	determination anduse of S-N-curves and classification of notch effects,
	<ul> <li>set up of determination of fatigue strength under dynamic load using the accumulation formula by Palmgren-Miner,</li> </ul>
Content	set up of determination of fatigue strength in different examples,
	basics of construction and design regarding the problem of material fatigue,
	basics of linear elastic fracture mechanics under static and dynamic load,
	<ul> <li>determination of lifetime of steel construction based on linear elastic fracture mechanics in different examples.</li> </ul>
	<ul> <li>Seeßelberg, C.; Kranbahnen - Bemessung und konstruktive Gestaltung; 3.</li> <li>Auflage; Bauwerk-Verlag; Berlin 2009</li> </ul>
	<ul> <li>Kuhlmann, Dürr, Günther; Kranbahnen und Betriebsfestigkeit; in Stahlbau Kalender 2003; Verlag Ernst &amp; Sohn; Berlin 2003</li> </ul>
	<ul> <li>Deutscher Stahlbau-Verband (Hrsg.); Stahlbau Handbuch Band 1 Teil B; 3.</li> <li>Auflage; Stahlbau-Verlagsgesellschaft; Köln 1996</li> </ul>
	• Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993
	• DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsregeln, Bemessungsregeln für den Hochbau; 1993
	DIN V ENV 1993-6: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 6: Kranbahnen; 2001
Literature	<ul> <li>DIN-Fachbericht 126. Richtlinie zur Anwendung von DIN V ENV 1993-6;</li> <li>Nationales Anwendungsdokument (NAD); Berlin 2002</li> </ul>

Course L0565: Fracture Mechanics and Fatigue	
Тур	Recitation Section (large)
Hrs/wk	1
СР	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Ingo Hadrych
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M0999	9: Steel Construction Pro	ject		
Courses				
<b>Title</b> Steel Construction Proj	ect (L1206)	<b>Typ</b> Project Seminar	Hrs/wk 4	<b>CP</b> 6
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous Knowledge	Steel and Composite Structures			
Educational Objectives	After taking part successfully, stude	ents have reached the fol	lowing learn	ing results
Professional Competence				
	Students are able to prepare a part Students can produce sketches and able to adjust their work in reacti participants of the project.	calculations of their part	t of the proje	ct. They are
Personal Competence				
Social Competence	Students can present their results to other members of the group.  They have the ability to work for a broad agreement with respect to intergroup dependencies.  They can distribute and process tasks independently.			
Autonomy	Students can handle their part of th	e project on their own re	sposibility-	
<b>Workload in Hours</b>	Independent Study Time 124, Study	/ Time in Lecture 56		
Credit points	6			
Course achievement	None			
-	Written elaboration			
Examination duration and scale	approx. 15-20 pages (without appe	ndix)		
the Following	Civil Engineering: Specialisation Geocivil Engineering: Specialisation Coocivil Engineering: Specialisation Str	astal Engineering: Electiv	e Compulsoi	

Course L1206: Steel Construction Project		
Тур	Project Seminar	
Hrs/wk	4	
СР	6	
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Prof. Marcus Rutner	
Language	DE	
Cycle		
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.	

Module M0663	3: Marine Geotechnics			
Courses				
Title		Тур	Hrs/wk	СР
Marine Geotechnics (L		Lecture Recitation	1 Section <sub>2</sub>	2
Marine Geotechnics (L		(large)	2	2
Steel Structures in Fou	ndation and Hydraulic Engineering (L1146)	Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous Knowledge	complete modules: Geotechnics I-III, Mai courses: Soil laboratory course	thematics I-III		
Educational Objectives	After taking part successfully, students h	nave reached	the following learr	ning results
Professional Competence <i>Knowledge</i> <i>Skills</i>				
Personal Competence Social Competence				
Autonomy				
	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale				
_	Civil Engineering: Specialisation Geotech Civil Engineering: Specialisation Structur Civil Engineering: Specialisation Coastal Theoretical Mechanical Engineering: Specialisation Coastal Theoretical Mechanical Engineering: Tompulsory Water and Environmental Engineering: Swater and Environmental Eng	ral Engineering Engineering: Decialisation Mechnical Com Specialisation Ong: Specialis	g: Elective Compul Compulsory Maritime Technolo aplementary Cour Cities: Elective Col ation Environmen	gy: Elective se: Elective mpulsory nt: Elective

Course L0548: Marine Geotechnics		
Тур	Lecture	
Hrs/wk	1	
СР	2	
<b>Workload in Hours</b>	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>	
<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 Sohn, Berlin</li> </ul>		

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

Course L1146: Steel Structures in Foundation and Hydraulic Engineering		
Тур	Lecture	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Frank Feindt	
Language	DE	
Cycle		
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 Repair of Structures (L Mineral Building Mater		<b>Typ</b> Lecture Lecture	Hrs/wk 1 2	<b>CP</b> 1 2
_	Building Materials (L0256)	Project-/problem-	1	2
	Building Materials and Damage Processes	based Learning Lecture	1	1
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge about building materials, building physics and building chemistry, for example by the modules Principles of Building Materials and Building Physics and Building Materials and Building Chemistry.			
Educational Objectives	After taking part successfully, students h	nave reached the foll	owing learn	ing results
Professional Competence				
Knowledge	The students are able to describe the components of mineral building materials and their function in detail and to use them for the manufacture of special mineral building materials. They are able to show the characteristics of mineral building materials. They are able to describe the manufacture, properties and fields of application of special mortars and special concretes and the correlations of their material parameters. They are able to show the principles of anchor technology and design.			
Skills	The students are able to perform an optimization of granulometry of a mineral building material. They are able to design a special mineral mortar and to manufacture this mortar. The students are able to manufacture post installed rebar connections. They are able to recognize damages, to assess possible causes, to use the fundamentals of construction preservation and to select repair and strengthening measures.			
Personal Competence Social Competence	The students are able to develop in small grous the mixture of a special mortar. They present their results to the lecturer and the other students. In a critical discussion they defend and adjust their results. The students are able to manufacture their special building material on the basis of this feedback.			
Autonomy	The students are able to responsibly use the resources of materials and lab equipment for their project and to investigate and to get missing components.			
	Independent Study Time 110, Study Tim	e in Lecture 70		
Credit points				
Course achievement	Yes 20 % Form Subject theory practical work	<b>Descrip</b> etical and	otion	
Examination				
Examination duration and scale				

Assig	nment	foı
the	<b>Follow</b>	ing
	Curric	ula

Civil Engineering: Specialisation Geotechnical Engineering: Compulsory
Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
Civil Engineering: Specialisation Water and Traffic: Elective Compulsory

Course L0255: Repair of Structures		
Тур	Lecture	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Frank Schmidt-Döhl	
Language	DE	
Cycle		
	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	
<b>Workload in Hours</b>	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	
<b>Workload in Hours</b>	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	
	Taylor, H.F.W.: Cement Chemistry	
Literature	Springenschmid, R.: Betontechnologie für die Praxis	

Course L0254: Transport Processes in Building Materials and Damage Processes		
Тур	Lecture	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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	

Module M0581	1: Water Protection			
Courses				
	Wastewater Management (L0226) Wastewater Management (L2008)	<b>Typ</b> Lecture Project Seminar	<b>Hrs/wk</b> 3 3	<b>CP</b> 3 3
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous Knowledge	Good knowledge in urban drainage;     Good knowledge of westewater treatment techniques:			
Educational Objectives	After taking part successfully, studer	its have reached the fo	ollowing learn	ing results
Professional Competence				
	The students can describe the basic principles of the regulatory framework related to the international and European water sector. They can explain limnological processes, substance cycles and water morphology in detail. They are able to assess complex problems related to water protection, such as ecosystem service and wastewater treatment with a special focus on innovative solutions, remediation measures as well as conceptual approaches.			
Skills	Students can accurately assess current problems and situations in a country-specific or local context. They can suggest concrete actions to contribute to the planning of tomorrow's urban water cycle. Furthermore, they can suggest appropriate technical, administrative and legislative solutions to solve these problems.			
Personal Competence	The students can work together in in	ternational groups.		
Social Competence				
Autonomy	Students are able to organize the discussions. They can acquire a independently.			
<b>Workload in Hours</b>	Independent Study Time 96, Study T	ime in Lecture 84		
Credit points				
Course achievement	None			
Examination	Presentation			

Examination duration and scale	Term paper plus presentation
Assignment for the Following Curricula	International Management and Engineering: Specialisation II. Civil Engineering:

Course L0226: Wat	er Protection and Wastewater Management
Тур	Lecture
Hrs/wk	3
СР	3
<b>Workload in Hours</b>	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Content	<ul> <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>
<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. ecinternat. ed.). Boston [u.a.]: Pearson Education International.</li> <li>Water and wastewater engineering: design principles and practice: Davis, I. 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
<b>Workload in Hours</b>	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	WiSe
Content	
Literature	

Damages				
Courses				
Title		Тур	Hrs/wk	СР
	als, Structural Condition and Damages	Lecture	3	4
(L0260)	als Structural Condition and Damages		_	4
(L0261)	als, Structural Condition and Damages	Recitation (small)	Section 1	2
Module	Prof. Frank Schmidt-Döhl			
Responsible	Prof. Frank Schmidt-Doni			
Admission Requirements	LNODE			
Recommended				
Previous	module Building Materials and Building		al science, for exa	imple by th
Knowledge		g Chemistry.		
Educational Objectives	LATTER TAKING NART SHCCESSTHIIV STHOEN	s have reached	the following learr	ning results
Professional	! !			
Competence				
	The students are able to describe			
Knowledge	construction products in Germany. <sup>-</sup> building material properties are usab			
	the most important testing methods.			
	The students are able to responsibl	v discover the r	rules for trading a	and using (
	building products in Germany.		_	_
	They are able to chose suitable			
Skills	construction products, the examination of damages and the examination of the structural conditions of buildings. They are able to conclude from symptons to the			
Skins	cause of damages. They are able to	describe an	examination in fo	rm of a te
	report or expert opinion.			
Personal				
Competence	! !		_	
	The students can describe the differ supervisory and certification bodies			
Social Competence	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			
,				
Autonomy	The students are able to make the specialist knowledge of a very extens		operation steps	to learn tr
Workload in Hours	Independent Study Time 124, Study		56	
Credit points				
Course	None			
acilievellielit				
	Written exam			
Examination duration and				
scale				
	Civil Engineering: Specialisation Struc	•		•
Assianment for	Civil Engineering: Specialisation Geot Civil Engineering: Specialisation Coas			
the Following	Civil Engineering: Specialisation Wate	r and Traffic: Ele	ective Compulsory	
Curricula	International Management and Eng	ineering: Specia	alisation II. Civil	Engineerin

Elective Compulsory Materials Science: Specialisation Engineering Materials: Elective Compulsory

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

Course L0261: Examination of Materials, Structural Condition and Damages	
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
<b>Workload in Hours</b>	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 M0603	3: Nonlinear Structural An	alysis		
Courses				
Title		Тур	Hrs/wk	СР
Nonlinear Structural A	nalysis (L0277)	Lecture	3	4
Nonlinear Structural Ar	nalysis (L0279) Recitation Section 1 2 (small)			2
Module Responsible	Prof. Alexander Düster			
Admission Requirements	None			
Recommended Previous Knowledge	Knowledge of partial differential equa	tions is recomme	ended.	
Educational Objectives	After taking part successfully, student	s have reached	the following lear	ning results
Professional				
Competence				
Knowledge	Students are able to			
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 nonlinear structural analysis. + critically verify and judge results of nonlinear finite elements. + to transfer their knowledge of nonlinear solution procedures to new problems.			
Personal Competence				
Social Competence	Students are able to + solve problems in heterogeneous results. + share new knowledge with group m		document the c	orresponding
Autonomy	Students are able to + acquire independently knowledge to	o solve complex	problems.	
Workload in Hours	Independent Study Time 124, Study T	ime in Lecture 5	6	
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale				
	Civil Engineering: Specialisation Struct International Management and Engineerive Compulsory Materials Science: Specialisation Model Mechatronics: Specialisation System D	neering: Special	ompulsory	

Assignment for the Following Curricula

Product Development, Materials and Production: Core qualification: Elective Compulsory
Naval Architecture and Ocean Engineering: Core qualification: Elective Compulsory
Ship and Offshore Technology: Core qualification: Elective Compulsory

Theoretical Mechanical Engineering: Technical Complementary Course: Elective

Theoretical Mechanical Engineering: Core qualification: Elective Compulsory

Theoretical Mechanical Engineering: Specialisation Simulation Technology: Elective

Compulsory

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

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

Module M1350	D: Excavation Law and P	rojects		
Courses				
Title Subsoil and Underground Engineering Law (L0395) Service Contract and Procurement Law (L1906) Project Geotechnics (L0708)		Typ Lecture Lecture Project-/problem- based Learning	Hrs/wk 2 2 2	<b>CP</b> 2 2 2
Module Responsible Admission	Prof. jurgen Grabe 			
Requirements  Recommended  Previous	None 			
Knowledge Educational Objectives	After taking part successfully, stud	ents have reached the fol	lowing learn	ing results
Professional Competence Knowledge				
Skills Personal Competence Social Competence				
Autonomy		Time in Lecture 84		
Credit points		Time in Lecture 04		
Course achievement				
Examination	Oral exam			
Examination duration and scale				
Assignment for the Following Curricula	Civil Engineering: Specialisation Co Civil Engineering: Specialisation Ge Civil Engineering: Specialisation St Civil Engineering: Specialisation Wa	otechnical Engineering: E ructural Engineering: Elec	lective Com tive Compul	pulsory

,	
Typ Lecture	
Hrs/wk 2	
<b>CP</b> 2	
Workload in Hours Independent Study Time 32, Study Time in Lecture 28	
<b>Lecturer</b> Prof. Günther Schalk	
Language DE	
<b>Cycle</b> WiSe	
History of Civil Engineering Law (from 1700 BC to 2000 AD)	
Basics of foundation and excarvation law / engineering law (the participa case law of geotechnical law case studies)	nts in the
Legal aspects of technical regulations in civil engineering (with case stud	es)
The civil engineering contract (including checklists for the special civil en contract design and execution)	gineering
• The liability of the planner and entrepreneur in civil engineering examples, jurisprudence and law, inter alia, to the Ordinance on Corliability for defects and traffic safety obligations, construction law and iquestions)	nbatants,
• The ground / foundation risk and the systemic risk (also in the European	context)
The total debt in (low) building law (based on practice-orient constellations)	ed case
The (construction) conflict, the dispute avoidance models and the corprocess (practice-oriented presentation)	struction
Folienskript (in der Vorlesung erhältlich)	
weitere Literatur:	
Englert, Grauvogel und Maurer: Handbuch des Baugrund- und Tiefb     Werner-Verlag	aurechts.

Course L1906: Service Contract and Procurement Law		
Тур	Lecture	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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 Geotechnics		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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	5: Metallic and Hybrid Lig	ght-weight Mate	rials	
Courses				
Title		Тур	Hrs/wk	СР
Joining of Polymer-Metal Lightweight Structures (L0500) Joining of Polymer-Metal Lightweight Structures (L0501) Metallic Light-weight Materials (L1660)		Lecture Practical Course Lecture	2 1 2	2 1 3
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional				
<b>Competence</b> <i>Knowledge</i>				
Skills				
Personal				
Competence				
Social Competence				
Autonomy				
<b>Workload in Hours</b>	Independent Study Time 110, Study	Time in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and scale	45 min			
Assignment for the Following Curricula	Civil Engineering: Specialisation Stru Materials Science: Specialisation En			

Course L0500: Join	ing of Polymer-Metal Lightweight Structures
Тур	Lecture
Hrs/wk	
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Marcus Rutner
Language	EN
Cycle	WiSe
Content	Contents:  The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-metal lightweight structures used in engineering applications. A general understanding of the principles of the consolidated and new technologies and its main fields of applications is to be accomplished through theoretical and practical lectures.  Theoretical Lectures:  Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics Mechanical Fastening of Polymer-Metal Hybrid Structures Adhesive Bonding of Polymer-Metal Hybrid Structures Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures  Laboratory Exercises:  Joining Processes: Introduction to state-of-the-art joining technologies Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints  Course Outcomes:  After successful completion of this unit, students should be able to understand the principles of welding and joining of polymer-metal lightweight structures as well as their application fields.
Literature	<ul> <li>S. T. Amancio-Filho, LA. Blaga, Joining of Polymer-Metal Hybrid Structures, Wiley, 2018</li> <li>J.F. Shackelford, Introduction to materials science for engineers, Prentice-Hall International</li> <li>J. Rotheiser, Joining of Plastics, Handbook for designers and engineers, Hanser Publishers</li> <li>D.A. Grewell, A. Benatar, J.B. Park, Plastics and Composites Welding Handbook</li> <li>D. Lohwasser, Z. Chen, Friction Stir Welding, From basics to applications, Woodhead Publishing Limited</li> <li>J. Friedrich, Metal-Polymer Systems: Interface Design and Chemical Bonding, Wiley, 2017</li> </ul>

Course L0501: Joining of Polymer-Metal Lightweight Structures		
Тур	Practical Course	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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					
Тур	Lecture				
Hrs/wk					
СР					
	Independent Study Time 62, Study Time in Lecture 28  Prof. Karl-Ulrich Kainer				
Language					
Cycle					
-	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 microstrumechanical qualities and applications					
Content	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** 

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

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Harry Chandler, Steel Metallurgy for the Non-Metallurgist 0-87170-652-0, 2006, 84 S.

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Literature

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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 M0619: Waste Treatment Technologies						
Courses						
Title			Тур		Hrs/wk	СР
Waste and Environmental Chemistry (L0328)				cal Course	2	2
Biological Waste Treatment (L0318)				t-/problem- Learning	3	4
Module Responsible	Prof. Kerstin Kuchta					
Admission Requirements	None					
Recommended Previous Knowledge	chemical and biological basics					
Educational Objectives	After taking part successfully, students have reached the following learning results					
Professional						
Competence						
Knowledge	The module aims possess knowledge concerning the planning of biological waste treatment plants. Students are able to explain the design and layout of anaerobic and aerobic waste treatment plants in detail, describe different techniques for waste gas treatment plants for biological waste treatment plants and explain different methods for waste analytics.					
Skills	The students are able to discuss the compilation of design and layout of plants. They can critically evaluate techniques and quality control measurements. The students can recherché and evaluate literature and date connected to the tasks given in der module and plan additional tests. They are capable of reflecting and evaluating findings in the group.					
Personal Competence	Church and markining	ata in aut	iii	. and intendi	i - I i	diagonaliana
Social Competence	Students can participate in subject-specific and interdisciplinary discussions, develop cooperated solutions and defend their own work results in front of others and promote the scientific development in front of colleagues. Furthermore, they can give and accept professional constructive criticism.					
Autonomy	Students can independently tap knowledge from literature, business or test reports and transform it to the course projects. They 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 accordance with the potential social, economic and cultural impact.					
Workload in Hours	Independent Study Tim	e 110. Study	Time in Le	cture 70		
Credit points		,		, <del>_</del>		
Course achievement	Compulsor <b>B</b> onus	Form Subject t practical wo	neoretical ork	<b>Descrip</b> t and	tion	
Examination	Presentation					
Examination						
	1					

duration and scale	Elaboration and Presentation (15-25 minutes in groups)
Assignment for the Following Curricula	Environmental Engineering: Core qualification: Compulsory  International Management and Engineering: Specialisation II Energy and

Course L0328: Waste and Environmental Chemistry					
Тур	Practical Course				
Hrs/wk	2				
СР	2				
<b>Workload in Hours</b>	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: Biol	ogical Waste Treatment			
Тур	Project-/problem-based Learning			
Hrs/wk	3			
СР	4			
<b>Workload in Hours</b>	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 M070	5: Groundwater			
Courses				
<b>Title</b> Geohydraulic and Solu	te Transport (L0539)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 2
Geohydraulic and Solu	·	Recitation	Section 1	1
Simulation in Groundw	rater Hydrology (L0541)	(small) Lecture	1	1
	rater Hydrology (L0542)	Recitation	Section 2	2
Module	NN	(small)		
Responsible Admission Requirements	None			
Recommended Previous Knowledge	<ul><li> Ground water hydrology</li><li> Hydromechanics</li></ul>			
Educational Objectives	After taking part successfully, stude	nts have reached	the following learn	ing results
Professional				
Competence		the fate of colute	s in the subsurfac	a along the
Knowledge	The students are able to describe the fate of solutes in the subsurface along the path between soil and water body quantitatively and qualitatively. They are able to do this with simulation models.			
Skills	The students are able to describe conceptually movement and storage of water in the unsaturated zone. They are able to analyse pF- functions and Ku functions. They can model transport of solutes in the unsaturated and saturated zoned. They are able to determine dispersiities, sorption coefficients, decay rates and dissolution rates for organic and inorganic substances.			
Personal Competence				
-	The students can help to each other.			
Autonomy Workload in Hours	none Independent Study Time 96, Study Time in Lecture 84			
Credit points		III Lecture 04		
Course achievement				
Examination	Written exam			
Examination duration and scale	60 min written exam and written pa	pers		
the Following	Civil Engineering: Specialisation Structivil Engineering: Specialisation Geoclivil Engineering: Specialisation Coacivil Engineering: Specialisation Water Engineering: Specialisation Compulsory  Process Engineering: Specialisation Water and Environmental Engineering Water and Environmental Engineering Compulsory  Water and Environmental Engineering Compulsory	otechnical Engineering: ter and Traffic: Ele n Environmental Process Engineering: Specialisation eering: Specialis	ering: Elective Com Elective Compulso ective Compulsory Process Engineering: Elective Compu Water: Compulsory ation Environmer	pulsory ry ng: Elective ulsory / nt: Elective

Course L0539: Geohydraulic and Solute Transport		
Тур	Lecture	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Wilfried Schneider	
Language	DE	
Cycle	WiSe	
Content	Pump test analysis, water content-water suction functions, unsaturated hydraulic conductivity function, Brooks-Corey relation, van Genuchten relation, solute transport in unsaturated zone, solute transport and reactions in groundwater	
Literature	Todd; K. (2005): Groundwater Hydrology  Fetter, C.W. (2001): Applied Hydrogeology  Hölting & Coldewey (2005): Hydrogeologie  Charbeneau, R.J. (2000): Groundwater Hydraulics and pollutant Transport	

Course L0540: Geohydraulic and Solute Transport		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Wilfried Schneider	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0541: Simulation in Groundwater Hydrology		
Тур	Lecture	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Sonja Götz (geb. Schröter)	
Language	DE	
Cycle	WiSe	
Content	Basics and theoretical background of simulation models frequently used in science and practise for pumping test analysis, water movement in vadose zone, solute transport in vadose zone, groundwater recharge, solute transport in groundwater	
Literature	Handbücher der verwendeten Slumationsmodelle werden bereitgestellt.	

Course L0542: Simulation in Groundwater Hydrology		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Sonja Götz (geb. Schröter)	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0722	2: Computa	tiona	l Analysis of	f Concre	te Strı	uctures	
Courses							
<b>Title</b> Computational Analysi	s of Concrete Stru	ıctures (L	0598)	<b>Typ</b> Lecture		Hrs/wk	<b>CP</b> 3
Computational Analysi	s of Concrete Stru	ıctures (L	0599)	Recitation (large)	Section	٦	1
FE-Modeling of Concre	te Structures (L06	500)		Project-/prol based Learn		2	2
Module Responsible	Prof. Günter Ro	mbach					
Admission Requirements	None						
	Basic knowledg (beams, slabs,		ctural analysis ar Ills).	nd design of	f reinforce	ed concret	e structures
Recommended Previous	Lectures 'Conc	rete Stru	ictures I und II'				
Knowledge	Lectures 'Struc	tural An	alysis I and II'				
	Lecture 'Concre	ete Struc	tures'				
Educational Objectives	After taking par	t succes	sfully, students h	ave reached	the follo	wing learn	ing results
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							
-	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 problems and results with other students.						
Workload in Hours	Independent St	udy Time	e 110, Study Time	e in Lecture	70		
Credit points							
	Compulsor <b>B</b> o	nus	Form		Descript		ster ist ein
Course achievement		ne	Attestation		Tragsyste Rechenpr modellier	m mi ogramm	
	Yes No	ne	Excercises			ein Trags ı modellier	
Examination	Oral exam						
Examination duration and scale							
Assignment for the Following Curricula	Civil Engineerin Civil Engineerin	g: Speci g: Speci	alisation Structura alisation Geotech alisation Coastal I alisation Water ar	nical Engine Engineering	ering: Ele : Elective	ective Com Compulso	pulsory

Course L0598: Com	putational Analysis of Concrete Structures		
Тур	Lecture		
Hrs/wk			
СР	3		
<b>Workload in Hours</b>	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: Computational Analysis of Concrete Structures		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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-N	Modeling of Concrete Structures
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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>

Module M080	1: Water Resources and	-Supply		
6				
Courses				
<b>Title</b> Chemistry of Drinking	Water Treatment (L0311)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 1
	Water Treatment (L0312)	Recitation	Section 1	2
Water Resource Manag		(large) Lecture	2	2
Water Resource Manag		Recitation	Section 1	1
		(small)		
Module Responsible	Prof. Mathias Ernst			
Admission Requirements	None			
	Knowledge of water manageme treatment.	ent and the key p	processes involve	ed in water
Educational Objectives	LATTER FAKING NART CHECKECTHING CTHE	lents have reached t	he following learr	ning results
Professional Competence				
Knowledge	Students will be able to outline key areas of conflict in water management, as well as their mutual dependence for sustainable water supply. They will understand relevant economic, environmental and social factors. Students will be able to explain and outline the organisational structures of water companies. They will be able to explain the available water treatment processes and the scope of their application.			
Skills	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 will 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 specifications for the state of the stat	ne management and appropriate profess will be able to devel	d treatment of dri sional position, t	nking water. for example
Autonomy	Students will be in a position to this subject.	work on a subject ir	ndependently and	d present on
Workload in Hours	Independent Study Time 96, Study	Time in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	60 min (chemistry) + presentation			
Assignment for	Civil Engineering: Specialisation St Civil Engineering: Specialisation Go Civil Engineering: Specialisation W Civil Engineering: Specialisation Co Energy and Environmental Engine	eotechnical Engineer ater and Traffic: Con pastal Engineering: E	ring: Elective Com npulsory Elective Compulso	npulsory

the Following	Engineering: Elective Compulsory
Curricula	International Management and Engineering: Specialisation II. Energy and
	Environmental Engineering: Elective Compulsory
	Water and Environmental Engineering: Specialisation Water: Compulsory
	Water and Environmental Engineering: Specialisation Environment: Elective
	Compulsory
	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory

Course L0311: Che	mistry of Drinking Water Treatment
Тур	Lecture
Hrs/wk	2
СР	1
<b>Workload in Hours</b>	Independent Study Time 2, Study Time in Lecture 28
Lecturer	Dr. Klaus Johannsen
Language	DE
Cycle	WiSe
	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).
Content	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.
	MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John
	Wiley & Sons, Hoboken, 2005.
	Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley & Sons, New York, 1996.
Literature	<b>DVGW (Hrsg.):</b> Wasseraufbereitung - Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004.
	<b>Jensen, J. N.</b> : A Problem Solving Approach to Aquatic Chemistry. John Wiley & Sons, Inc., New York, 2003.

Course L0312: Chemistry of Drinking Water Treatment	
Тур	Recitation Section (large)
Hrs/wk	1
СР	2
<b>Workload in Hours</b>	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 Resource 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 Resource Management	
Тур	Recitation Section (small)
Hrs/wk	1
СР	1
<b>Workload in Hours</b>	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

Module M0858	3: Coastal Hydraulic En	gineer	ing I		
Courses					
<b>Title</b> Basics of Coastal Engir	neering (L0807)	Le	<b>yp</b> ecture	Hrs/wk 3	<b>CP</b> 4
Basics of Coastal Engir	neering (L1413)		roject-/problem- ased Learning	1	2
- Respensione					
Admission Requirements	None				
Recommended Previous Knowledge	Basics of hydraulic engineering, h	ydrology	and hydromechani	cs	
Educational Objectives	After taking part successfully, stu	dents hav	e reached the follo	wing learn	ing results
Professional Competence					
•	The students are able to define and explain the basic concepts of coastal engineering and port engineering. They are able to apply the concepts to selected practical problems of coastal engineering. Students can define and determine the basics for design and dimensioning of coastal engineering constructions.				
Skills	The students are capable to apply basic design approaches to selected and predefined design tasks in coastal engineering.				
Personal Competence					
Social Competence	The students are able to deploy their gained knowledge in applied problems such as the design of coastal protection structures. 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.				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points					
Course achievement	None				
Examination	Written exam				
Examination duration and scale	respect to the general understanding of the lecture contents and calculations tasks.				
the Following	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Compulsory Civil Engineering: Specialisation Coastal Engineering: Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory				

Course L0807: Basics of Coastal Engineering		
Тур	Lecture	
Hrs/wk	3	
СР	4	
<b>Workload in Hours</b>	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Prof. Peter Fröhle	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Design-approaches</li> <li>Filter</li> <li>Rubble mound constructions</li> <li>Piles</li> <li>Vertical constructions</li> </ul>	
Literature	Coastal Engineering Manual, CEM  Vorlesungsumdruck	

Course L1413: Bas	Course L1413: Basics of Coastal Engineering	
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	2	
<b>Workload in Hours</b>	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	

Caa =				
Courses				
<b>Title</b> Integrated Transportat	tion Planning (L1068)	<b>Typ</b> Project-/problem- based Learning	Hrs/wk 4	<b>CP</b> 6
Module Responsible	Prof. Carsten Gertz			
Admission Requirements	INONE			
	some knowledge of transport plann "Transport Planning and Traffic Eng		the undergra	aduate clas
Educational Objectives		ents have reached the fol	lowing learn	ing results
Professional Competence				
Knowledge	<ul> <li>describe interdependent transportation/mobility behated the social and land-use policy measure relate current issues in the formulate an opinion on them.</li> </ul>	viour .ial, ecological and econo s. .e area of integrated t	mic effects	
Skills	Students are able to:  • quantify important parame influenced by it. • comprehensively examine transportation studies persp with scientific conventions.	a pre-defined or self-s	selected to	pic from
Personal Competence				
Social Competence	<ul> <li>provide feedback on topical of constructively handle feedback</li> <li>produce results in group wor</li> </ul>	ck on their own work.	ng.	
Autonomy	Students are able to:      assess potential consequenc     independently plan working     necessary knowledge and us	on a pre-defined pro	ject topic,	acquire th
Workload in Hours	Independent Study Time 124, Study	/ Time in Lecture 56		
Credit points				
Course	None			

Examination	Written elaboration
Examination duration and scale	written assignment with presentation during the semester
Assignment for the Following Curricula	Logistics, intrastructure and Mobility: Specialisation intrastructure and Mobility:

Course L1068: Integrated Transportation Planning		
Тур	Project-/problem-based Learning	
Hrs/wk	4	
СР	6	
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Prof. Carsten Gertz, Dr. Philine Gaffron, Jacqueline Bianca Maaß	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>The course will provide students with an understanding of interdependencies between land-use and transportation. Specific topics include a.o.:         <ul> <li>interactions between transport and the environment and consequent limitations</li> <li>characteristics of integrated planning</li> <li>complex planning processes</li> <li>interdependencies of location choice and mobility behaviour</li> <li>transport and land-use policies</li> <li>project on current issues in transportation studies</li> </ul> </li> </ul>	
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	1: Underground Construct	ions		
Courses				
Title Applied Tunnel Construint Introduction to tunnel	construction (L0707)	<b>Typ</b> Lecture Lecture Recitation	Hrs/wk 2 1 Section 1	<b>CP</b> 3 2
Introduction to tunnel	construction (L1811)	(large)	1	1
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	none			
Recommended Previous Knowledge		nd environmenta	al engineering:	
Educational Objectives	After taking part successfully, studen	ts have reached	the following learn	ing results
Professional Competence				
Knowledge	Knowledge 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 quay walls. Futhermore, the students get all the neccessary knowledge to design singular construction elements for sheet pile walls and they know how to choose the right construction elements depending on the influencing conditions.			
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			
Personal Competence				
	Capacity for teamwork concerning pr	oject manageme	nt and design of tu	unnels.
Autonomy	Promotion of independent and crea exercise.			
Workload in Hours	Independent Study Time 124, Study	Time in Lecture 5	56	
Credit points	6			
Course achievement	None			
	Written exam			i
Examination duration and scale				
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory 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: App	Course L2407: Applied Tunnel Constructions	
Тур	Lecture	
Hrs/wk	2	
СР	3	
<b>Workload in Hours</b>	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		
	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	<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	
СР	1	
<b>Workload in Hours</b>	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	9: Selected Topics in Civil I	Engineering		
Courses				
	onal Project Delivery (L2387)	Typ Lecture Integrated Lecture Lecture	<b>Hrs/wk</b> 1 2	<b>CP</b> 1 2 1
Design of Prefabricated Concrete Structures (L0596)  Design of Prefabricated Concrete Structures (L0597)		Recitation Section	_	1
Forum I - Geotechnics Forum II - Geotechnics Geotechnical Engineer Timber Structures (L11 Glass Structures (L115	and Construction Management (L1634) and Construction Management (L1635) ing Design (L2447) .51) 2)	(large) Seminar Seminar Lecture Seminar Lecture Recitation Section	1 1 2 2 2	1 1 3 2 2
Special topics of civil e	ngineering 1CP (L2378) ngineering 2 LP (L2379) ngineering 3 LP (L2380)	(large)  Lecture	'1 1 2 3 1	1 1 2 3 1
i i coponono	Prof. Uwe Starossek			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, students	s have reached the follo	wing learr	ning 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	<ul> <li>Students are able to apply bastructural engineering.</li> </ul>	asic methods in selecto	ed areas	of civil and
Personal Competence Social Competence				
Autonomy	• Students can chose independently, in which fields they want to deepen their			
Workload in Hours	Depends on choice of courses			
Credit points	· · · · · · · · · · · · · · · · · · ·			
Assignment for the Following Curricula	Civil Engineering: Specialisation Struct Civil Engineering: Specialisation Geote	chnical Engineering: Ele al Engineering: Elective	ctive Con Compulso	npulsory

Course L1867: Ana	lysis of Offshore Structures
Тур	Lecture
Hrs/wk	1
СР	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
Examination Form	
Examination duration and 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
Content	Topic 5: Linear-Time-Invariant Systems, response of an LTI-system in frequency domain
Content	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
	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
Literature	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	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
<b>Examination Form</b>	laut FSPO	
Examination duration and scale	wird zu Beginn der Lehrveranstaltung festgelegt	
Lecturer	NN	
Language	EN	
Cycle	SoSe	
Content		
Literature		

Course L0596: Design of Prefabricated Concrete Structures		
Тур	Lecture	
Hrs/wk		
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
<b>Examination Form</b>	Klausur	
Examination duration and 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> </ul>	

Course L0597: Design of Prefabricated Concrete Structures		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
<b>Examination Form</b>	Klausur	
Examination duration and scale	Siehe korrespondierende Vorlesung	
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	
<b>Examination Form</b>	Mündliche Prüfung	
Examination duration and scale	30 min	
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	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
<b>Examination Form</b>	Mündliche Prüfung	
Examination duration and 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	
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28	
<b>Examination Form</b>	Schriftliche Ausarbeitung	
Examination duration and scale	45 Min.	
Lecturer	Prof. Jürgen Grabe, 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	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
<b>Examination Form</b>	Referat	
Examination duration and scale	90 min	
Lecturer	Prof. Torsten Faber	
Language	DE	
Cycle	WiSe	
Content		
Literature		

Course L1152: Glass Structures		
Тур	Lecture	
Hrs/wk	2	
СР	2	
	Independent Study Time 32, Study Time in Lecture 28	
<b>Examination Form</b>	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
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Examination Form</b>	Mündliche Prüfung
Examination duration and scale	
Lecturer	Marvin Matzik
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L2378: Special topics of civil engineering 1CP	
Тур	
Hrs/wk	1
СР	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Examination Form</b>	laut FSPO
Examination duration and scale	wird zu Beginn der Lehrveranstaltung festgelegt
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	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
<b>Examination Form</b>	laut FSPO	
Examination duration and scale	wird zu Beginn der Lehrveranstaltung festgelegt	
Lecturer	Dozenten des SD B	
Language	DE	
	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	
<b>Workload in Hours</b>	Independent Study Time 48, Study Time in Lecture 42	
<b>Examination Form</b>	laut FSPO	
Examination duration and scale	wird zu Beginn der Lehrveranstaltung festgelegt	
Lecturer	Dozenten des SD B	
Language	DE	
	WiSe/SoSe	
Content	The course occurs only if required. The content is defined at short notice.	
Literature	Die Literatur wird kurzfristig festgelegt.	

Course L1905: Wind turbine design		
Тур	Lecture	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
<b>Examination Form</b>	Mündliche Prüfung	
Examination duration and scale	30 min	
Lecturer	Dr. Jörn Scheller	
Language	DE	
Cycle	WiSe	
Content		
Literature		

Module M0965	5: Study Work Structural Engineering
Courses	
Title	Typ Hrs/wk CP
Admission Requirements	None
Recommended Previous Knowledge	Subjects of the Structural Engineering specialisation.
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
	The students are able to demonstrate their detailed knowledge in the field of structural and construction engineering. They can exemplify the state of technology and application and discuss critically in the context of actual problems and general conditions of science and society.
Knowledge	The students can develop solving strategies and approaches for fundamental and practical problems in structural and construction engineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view points of science and society.
	Scientific work techniques that are used can be described and critically reviewed.
Skills	The students are able to independently select methods for the project work and to justify this choice. They can explain how 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	
•	The students are able to condense the relevance and the structure of the project work, the work steps and the sub-problems for the presentation and discussion ir front of a bigger group. They can lead the discussion and give a feedback on the project to their colleagues.
Autonomy	The students are capable of independently planning and documenting the work steps and procedures while considering the given deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedback from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology.
Workload in Hours	Independent Study Time 180, Study Time in Lecture 0
Credit points	
Course achievement	
Examination	
Examination duration and scale	
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Compulsory

Module M0997: Structural Analysis - Selected Topics				
Courses				
-	rame Structure (L1200)	<b>Typ</b> Lecture Lecture Recitation	Hrs/wk 2 2 Section 2	<b>CP</b> 2 2
Nonlinear Analysis of F	rame Structure (L1201)	(large)	2	2
Module Responsible	Prof. Uwe Starossek			
Admission Requirements	None			
Recommended Previous Knowledge	Mechanics I/II, Mathematics I/II,	Differential Equations I		
Educational Objectives	After taking part successfully, st	tudents have reached th	ne following learn	ing results
Professional Competence	After successful completion of to figher structural analysis.	his module, students ca	an explain selecte	ed elements
Knowledge Skills	After successful completion of			
Personal	premises and the applicability analysis. They are able to use th			
Competence				
Social Competence	<ul> <li>Students can</li> <li>participate in subject-spe</li> <li>defend their own work re</li> <li>promote the scientific de</li> <li>Furthermore, they can given</li> </ul>	sults in front of others velopment of colleague:	5	riticism
Autonomy	The students have the opportur problems.	nity to voluntarily and in	dependently worl	k homework
Workload in Hours	Independent Study Time 96, Stu	udy Time in Lecture 84		
Credit points	6			
Course achievement	None			
Examination Examination duration and scale				
the Following	Civil Engineering: Specialisation Civil Engineering: Specialisation Civil Engineering: Specialisation	Geotechnical Engineeri	ng: Elective Com	pulsory

Course L1199: Plat	es and Shells	
Тур	Lecture	
Hrs/wk		
СР	2	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Jürgen Priebe	
Language	DE	
Cycle	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> <li>Zienkiewicz, O.C. (1977): The Finite Element Method in Enginieering Science. McGraw-Hill, London</li> </ul>	

Course L1200: Nonlinear Analysis of Frame Structure			
Тур	Lecture		
Hrs/wk	2		
СР	2		
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Uwe Starossek		
Language	DE		
Cycle	WiSe		
	-Types of nonlinearity -relevance of nonlinear effects on structural analysis		
	-comparison and classification of $1^{\rm st}$ order theory, $2^{\rm nd}$ order theory and $3^{\rm rd}$ 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		
Content	displacement method $ \begin{array}{c} \text{-fundamentals of analytical application of 2}  ^{\text{nd}}  \text{order elasticity theory: derivation and solution of differential equation} \\ \end{array} $		
	-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 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

Module M15 Engineering ( <i>I</i>	05: Adaptation to Climate Change in Hydraulic AKWAS)
Courses	
Title	Typ Hrs/wk CP
Adaptation to climate	change in hydraulic engineering (L2291)  Project-/problem- based Learning  6
Module Responsible	i Prot Perer Fronie
Admission Requirements	None
Recommended Previous Knowledge	Hydromechanic, Hydraulics     Fundamentals of Coastal Engineering, Coastal, and Flood Protection
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	<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>
Skills	<ul> <li>Critical thinking: analysis of processes and relations, assessment of needs for action</li> <li>Creative thinking: development of adaptation strategies and adaptation measures</li> <li>Practical thinking: inclusion of restrictions, application of calculation approaches, methods, numerical models, planning methods</li> <li>Consideration of complex tasks</li> </ul>
Personal Competence	
Social Competence	<ul> <li>Working in heterogenous groups</li> <li>Working with different scientific / non-scientific disciplines</li> <li>Self reflection</li> </ul>
Autonomy	<ul> <li>Application oriented use of knowledge and skills</li> <li>Autonomous work on complex tasks</li> </ul>
	Independent Study Time 124, Study Time in Lecture 56
Credit points	
Course achievement	None
Examination	Written elaboration

Examination duration and scale	Preparation of a written report and a presentation of a complex task.
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory 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	
<b>Workload in Hours</b>	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 M0964	4: Underground Construc	tions		
Courses				
<b>Title</b> Applied Tunnel Construintroduction to tunnel		<b>Typ</b> Lecture Lecture	<b>Hrs/wk</b> 2 1	<b>CP</b> 3 2
Introduction to tunnel		Recitation (large)	Section 1	1
	Prof. Jürgen Grabe			
Admission Requirements	LNODE			
Recommended Previous Knowledge	Geotechnics I-II	and environmental	engineering:	
Educational Objectives	LATTER TAKING NART CHCCECCTIIIIV CTHGE	nts have reached tl	he following lear	ning results
Professional Competence				
Knowledge	Knowledge 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 quay walls. Futhermore, the students get all the neccessary knowledge to design singular construction elements for sheet pile walls and they know how to choose the right construction elements depending on the influencing conditions.			
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 and connections.			
Personal				
Competence Social Competence	I Capacity for teamwork concerning p	roiect managemen	t and design of	unnels.
Autonomy	Promotion of independent and creative work flow in the framework of a design exercise.			
<b>Workload in Hours</b>	Independent Study Time 124, Study	Time in Lecture 56	5	
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 minutes			
Assignment for the Following Curricula	Civil Engineering: Specialisation Stru Civil Engineering: Specialisation Geo Civil Engineering: Specialisation Coa Civil Engineering: Specialisation Wat International Management and En Elective Compulsory	technical Engineer stal Engineering: C er and Traffic: Elec	ing: Compulsory ompulsory tive Compulsory	,

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

Course L0707: Intro	oduction to tunnel construction
Тур	Lecture
Hrs/wk	1
СР	2
<b>Workload in Hours</b>	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	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Marius Milatz	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Damages				
Courses				
Title		Тур	Hrs/wk	СР
	ls, Structural Condition and Damages	Lecture	3	4
(L0260) Examination of Materia (L0261)	ls, Structural Condition and Damages	Recitation (small)	Section 1	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge about building mate module Building Materials and Buildin		al science, for exa	mple by t
Educational Objectives	After taking part successfully, student	s have reached	the following learr	ning results
Professional Competence				
Knowledge	The students are able to describe the rules for trading, use and marking of construction products in Germany. They know which methods for the testing of building material properties are usable and know the limitations and characterics of the most important testing methods.			
Skills	The students are able to responsibly discover the rules for trading and using obuilding products in Germany.  They are able to chose suitable methods for the testing and inspection construction products, the examination of damages and the examination of the structural conditions of buildings. They are able to conclude from symptons to the cause of damages. They are able to describe an examination in form of a test report or expert opinion.			
Personal Competence				
	The students can describe the difference supervisory and certification bodies we can describe the different roles of the	vithin the frame	ework of material t	
Autonomy	The students are able to make the timing and the operation steps to learn the specialist knowledge of a very extensive field.			
Workload in Hours	Independent Study Time 124, Study T	ime in Lecture !	56	
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	120 min			
the Following	Civil Engineering: Specialisation Struc Civil Engineering: Specialisation Geoto Civil Engineering: Specialisation Coast Civil Engineering: Specialisation Wate International Management and Eng	echnical Engine cal Engineering: r and Traffic: Ele	ering: Elective Com Elective Compulso ective Compulsory	npulsory ery

Elective Compulsory Materials Science: Specialisation Engineering Materials: Elective Compulsory

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

Course L0261: Examination of Materials, Structural Condition and Damages		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
<b>Workload in Hours</b>	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	СР
Integrated Transportat	ion Planning (L1068)		<b>Typ</b> Project-/problem- based Learning	4	6
Module Responsible	Prof. Carsten Gertz				
Admission Requirements	None				
	some knowledge of "Transport Planning		g, e.g. through taking eerin	the undergr	aduate cla
Educational Objectives	After taking part suc	ccessfully, student	s have reached the fo	ollowing learr	ning results
Professional Competence	Students are able to	):			
Knowledge	<ul><li>explain and e and land-use</li><li>relate currer</li></ul>	policy measures.		nomic effects	
Skills	influenced by • comprehensing transportation	oortant paramete it. vely examine a	ers, which influence pre-defined or self tive and document t	-selected to	pic from
Personal Competence	Students are able to	):			
Social Competence	<ul> <li>constructively</li> </ul>	y handle feedback	ntents and their teach on their own work. and document these.	ning.	
Autonomy	<ul> <li>independentl</li> </ul>	tial consequences y plan working	of their future profess on a pre-defined pr appropriate means for	oject topic,	acquire tl
Workload in Hours	Independent Study	Time 124, Study T	ime in Lecture 56		
Credit points					
Course achievement	None				

Examination	Written elaboration
Examination duration and scale	written assignment with presentation during the semester
Assignment for the Following Curricula	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility:

Course L1068: Integrated Transportation Planning		
Тур	Project-/problem-based Learning	
Hrs/wk	4	
СР	6	
<b>Workload in Hours</b>	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Prof. Carsten Gertz, Dr. Philine Gaffron, Jacqueline Bianca Maaß	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>The course will provide students with an understanding of interdependencies between land-use and transportation. Specific topics include a.o.:         <ul> <li>interactions between transport and the environment and consequent limitations</li> <li>characteristics of integrated planning</li> <li>complex planning processes</li> <li>interdependencies of location choice and mobility behaviour</li> <li>transport and land-use policies</li> <li>project on current issues in transportation studies</li> </ul> </li> </ul>	
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 M080	1: Water Resources and	-Supply		
6				
Courses				
<b>Title</b> Chemistry of Drinking	Water Treatment (L0311)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 1
Chemistry of Drinking Water Treatment (L0312)		Recitation	Section 1	2
Water Resource Manag		(large) Lecture	2	2
Water Resource Manag		Recitation	Section 1	1
		(small)		
Module Responsible	Prof. Mathias Ernst			
Admission Requirements	None			
	Knowledge of water manageme treatment.	ent and the key p	processes involve	ed in water
Educational Objectives	LATTER FAKING NART CHECKECTHING CTHE	lents have reached t	he following learr	ning results
Professional Competence				
Knowledge	Students will be able to outline key areas of conflict in water management, as well as their mutual dependence for sustainable water supply. They will understand relevant economic, environmental and social factors. Students will be able to explain and outline the organisational structures of water companies. They will be able to explain the available water treatment processes and the scope of their application.			
Skills	Students will be able to assess co establish solutions involving water be able to assess the evaluation mable to carry out chemical calcula generally accepted technical rules	r management and the thods that can be tions for selected tr	technical measur used for this. Stu eatment processe	es. They will dents will be
Personal Competence				
Social Competence	Working in a diverse group of specification of the document complex solutions for the take and t	ne management and appropriate profess will be able to devel	d treatment of dri sional position, t	nking water. for example
Autonomy	Students will be in a position to this subject.	work on a subject ir	ndependently and	d present on
Workload in Hours	Independent Study Time 96, Study	Time in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	60 min (chemistry) + presentation			
Assignment for	Civil Engineering: Specialisation St Civil Engineering: Specialisation Go Civil Engineering: Specialisation W Civil Engineering: Specialisation Co Energy and Environmental Engine	eotechnical Engineer ater and Traffic: Con pastal Engineering: E	ring: Elective Com npulsory Elective Compulso	npulsory

	Engineering: Elective Compulsory
Curricula	International Management and Engineering: Specialisation II. Energy and
	Environmental Engineering: Elective Compulsory
	Water and Environmental Engineering: Specialisation Water: Compulsory
	Water and Environmental Engineering: Specialisation Environment: Elective
	Compulsory
	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory

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

Course L0312: Chemistry of Drinking Water Treatment		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	2	
<b>Workload in Hours</b>	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: Wat	er Resource 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 Resource Management		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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	

Cources				
Courses				
Title Integrated Pollution Co	ontrol (L0502)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 2
Integrated Pollution Control (L0502) Health, Safety and Environmental Management (L0387)		Lecture	2	3
-	vironmental Management (L0388)	Recitation	Section 1	1
		(small)		
1100 01101101				
Admission Requirements	INONE			
Recommended Previous Knowledge	integrated solutions)  • Good knowledge of the relev	ant Environmental L	egislation	end-of-pipe
Educational Objectives	I ALI PELLAKING NATI SHEEPSSHIIIV SHIGE	nts have reached th	ne following learn	ing results
Professional Competence				
Knowledge	The students are able to describe the basics of regulations, economic instrument voluntary initiatives, fundamentals of HSE legislation ISO 14001, EMAS ar Responsible Care ISO 14001 requirements. They can analyse and discuss industri processes, substance cycles and approaches from end-of-pipe technology to ecefficiency and eco-effectiveness, showing their sound knowledge of completindustry related problems. They are able to judge environmental issues and widely consider, apply or carry out innovative technical solutions, remediation measures and further interventions as well as conceptual problem solving approaches in the full range of problems in different industrial sectors.			
Skills	Students are able to assess cur environmental protection. They ca plan and suggest concrete actions means they can solve problems on	n consider the best n a company- or bro	available techni anch-specific con	ques and text. By th
Personal Competence Social Competence	The students can work together in i	nternational groups		
Autonomy	Students are able to organize presentations and contributions to knowledge by making enquiries ind	the discussions. T		
Workload in Hours	I Independent Study Time 110, Study	Time in Lecture 70		
Credit points				
Course				
achievement	None			
Examination	Written exam			
Examination				

duration and scale	
Assignment for the Following Curricula	Joint European Master in Environmental Studies - Cities and Sustainability:

Course L0502: Inte	grated Pollution Control
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	WiSe
Content	<ul> <li>The lecture focusses on:</li> <li>The Regulatory Framework</li> <li>Pollution &amp; Impacts, Characteristics of Pollutants</li> <li>Approaches of Integrated Pollution Control</li> <li>Sevilla Process, Best Available Technologies &amp; BREF Documents</li> <li>Case Studies: paper industry, cement industry, automotive industry</li> <li>Field Trip</li> </ul>
Literature	Förstner, Ulrich (1998): Integrated Pollution Control, Springer-Verlag Berlin Heidelberg, ISBN 978-3-642-80313-0  Shen, Thomas T. (1999): Industrial Pollution Prevention, Springer-Verlag Berlin Heidelberg, ISBN 978-3-540-65208-3

Course L0387: Health, Safety and Environmental Management		
Тур	Lecture	
Hrs/wk	2	
СР	3	
<b>Workload in Hours</b>	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	
<b>Workload in Hours</b>	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 (L0517)	Lecture	2	3
Air Pollution Abatemen		Lecture	2	3
Module Responsible	Dr. Swantje Pietsch			
Admission Requirements	LNIONE			
	Basic knowledge of biology	and chemistry		
Recommended Previous Knowledge	basic knowledge of solids process engineering and separation technology			
Educational Objectives	After taking part successfull	y, students have reached the	e following learr	ning results
Professional Competence				
Knowledge	<ul> <li>After successful completion of the module students are able to</li> <li>name and explain biological processes for waste water treatment,</li> <li>characterize waste water and sewage sludge</li> <li>discuss legal regulations in the area of emissions and air quality</li> <li>classify off gas tretament processes and to define their area of application</li> </ul>			
Skills		ocesss steps for the biologic or cleaning of off-gases de s		
Personal				
Competence				
Social Competence Autonomy				
-	Independent Study Time 12	1 Study Time in Lecture 56		
Credit points		+, Study Time in Lecture 30		
Course achievement				
Examination	Written exam			
Examination duration and scale				
Assignment for the Following Curricula	Haint Europaan Mactar in	ecialisation A - General Biopongineering: Specialisation G Engineering: Specialisation Specialisation Waste and Engineering: Specialisation Waste and Engineering: Specialisation Specialisation Waste and Engineering: Specialisation Waste and Engineering: Specialisation Waste and Engineering: Specialisation Waste Specialisation G	rocess Engineer eneral Process Environmental nergy: Elective C ialisation II. I	Engineerin Engineerin Compulsory Energy ar ustainabilit

Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory

Process Engineering: Specialisation Process Engineering: Elective Compulsory Water and Environmental Engineering: Specialisation Water: Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Compulsory Water and Environmental Engineering: Specialisation Cities: Compulsory

Course L051	7: Biological Wastewater Treatment
Тур	Lecture
Hrs/wk	
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 Biofilm 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 (IGb.)) 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

Viewea, 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 Abatement		
Тур	Lecture	
Hrs/wk	2	
СР	3	
<b>Workload in Hours</b>	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	

Module M0826	6: Biology, Geology ar	nd Chemistry		
Courses				
Title		Тур	Hrs/wk	СР
Biology (L1428) Geology and Soil Scien	nce (L0003)	Lecture Lecture	2 2	2 1
Environmental Analysis		Lecture	2	3
Module Responsible	IIIr IInrothea Rechtenhach			
Admission Requirements	None			
Recommended Previous Knowledge		anic chemistry and biolog	y (knowledge	acquired at
Educational Objectives	After taking part successfully, s	tudents have reached the	following learn	ing results
Professional				
Competence	! !	e della attendanta aggina a	البرمويا الحصيية	of +b o
Knowledge	With the completion of this module students acquire profound knowledge of the geo- and pedosphere, biogeochemical processes and the fate of migrating compounds in soil and groundwater. They learn about methods to investigate sites for different use.			
Skills	With the completion of this module students can apply the acquired theoretical knowledge to model sites and assess the situation technically and conceptually. They are able to draw comparisons on different investigation strategies and techniques. Model projects can be devised and treated.			
Personal Competence				
	Students can discuss technical and interdisciplinary .	and scientific tasks within	a seminar sub	ject specific
Autonomy	Students can independently extended the subject and apply it to new		ne particular kr	nowledge o
Workload in Hours	Independent Study Time 96, Stu	udy Time in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			_
Examination duration and scale	2 Std. 15 Min.			
Assignment for the Following Curricula	Water and Environmental Engin			

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

Course L0903: Geology and Soil Science		
Тур	Lecture	
Hrs/wk	2	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 2, Study Time in Lecture 28	
Lecturer	Dr. Joachim Gerth, Sonja Götz (geb. Schröter)	
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	<ul> <li>R. Vinx (2011): "Gesteinsbestimmung im Gelände"</li> <li>H. Bahlburg &amp; C. Breitkreutz (2012): "Grundlagen der Geologie", TUB Signatur GWB-318</li> <li>R. Walter (2003): "Ergeschichte" TUB Signatur: 2816-1769</li> <li>F.Scheffer und P. Schachtschabel (2002): "Lehrbuch der Bodenkunde" TUB Signatur AGG-308</li> <li>W.E.H. Blum (2007): "Bodenkunde in Stichworten" TUB Signatur AGG-317</li> </ul>	

Course L0354: Environmental Analysis		
Тур	Lecture	
Hrs/wk	2	
СР	3	
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Dorothea Rechtenbach, Dr. Henning Mangels	
Language	EN	
Cycle	WiSe	
	Introduction	
	Sampling in different environmental compartments, sample transportation, sample storage	
	Sample preparation	

Photometry

Wastewater analysis

**Content** Introduction into chromatography

Gas chromatography

**HPLC** 

Mass spectrometry

Optical emission spectrometry

Atom absorption spectrometry

Quality assurance in environmental analysis

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 lannelli (Translator), Eric lannelli (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)

## Literature

- 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)

of Chemistry, Atomic absorption spectometry Royal Society (http://www.kau.edu.sa/Files/130002/Files/6785 AAs.pdf)

Module M1403	3: Construction	and Simul	ation of Sew	erage Syst	ems
Courses					
<b>Title</b> Construction and reno Simulation of sewerag	vation of urban sewer sys e systems (L2006)	tems (L1998)	<b>Typ</b> Seminar Seminar	<b>Hrs/wk</b> 3 3	<b>CP</b> 3 3
Module Responsible	Prof. Ralf Otterpohl				
Admission Requirements					
Recommended Previous Knowledge	Mechanics     Soil mechanics:	and foundation	engineering	vater manageme	nt
Educational Objectives	After taking part succe	essfully, student	s have reached th	e following learn	ing results
Professional Competence					
Knowledge	Students can describe urban wastewater systems by means of software-based modeling. In case studies they can perform system 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.				
	Students have knowledge of static and structural requirements of the sewer system. Cases of damage are investigated and the knowledge regarding different renovation technologies for sewer systems is acquired.				
Skills	The students can simu dimension the sewer seconstruction materials	systems accord	lingly. Moreover, t	hey can determ	ine suitable
Personal Competence					
Social Competence	Students are able to knowledge.	apply the acc	quired skills in a	team and can	impart this
Autonomy	Students can solve p concerning in partic Furthermore, they are	cular dimensio	ning and simu	lation of sewe	
Workload in Hours	Independent Study Tin	ne 96, Study Tir	me in Lecture 84		
Credit points	6				
Course achievement	CompulsorBonus No 20 %	<b>Form</b> Presentation	De	scription	
Examination	Written elaboration				
Examination duration and scale	nach Absprache				
Assignment for the Following Curricula	Civil Engineering: Spec Water and Environmer	ntal Engineering	ı: Specialisation W	ater: Compulsor	

## Course L1998: Construction and renovation of urban sewer systems

	Seminar		
Hrs/wk			
СР			
	Independent Study Time 48, Study Time in Lecture 42		
	Prof. Ingo Weidlich		
Language			
Cycle			
Content	Construction:  Pipe materials, type Open trenches Trenchless technolo Pipe Statics:  Design of sewers ac Earth pressure on p Comparison with ot Renovation:  Failure case study	ccording to ATV A 127 sipes, pipe deformation, cutting forces her international calculation approaches ferent renovation technologies	
Literature	Nr.  1  2  3  4  5  6  7  8	Titel ATV A 127, Abwassertechnisch- Vereinigung e.V., Arbeitsblatt A 127 Regelwerk Abwasser-Abfall, Vertrieb GFA, DK 628.22 (083),A 127, 2000 DIN EN 1610, Verlegung und Prüfung vo Abwasserleitungen und -kanälen, Beut Verlag, Berlin, 1997 Arbeitsblatt DWA-A 143-1, Sanierung vo Entwässerungssystemen außerhalb vo Gebäuden, Teil 1: Planung un Überwachung vo Sanierungsmaßnahmen Februar 2015 Arbeitsblatt DWA-A 143-2, Sanierung vo Entwässerungssystemen außerhalb vo Gebäuden Teil 2: Statische Berechnun zur Sanierung von Abwasserleitunge und -kanälen mit Lining un Montageverfahren, Juli 2015 D I N EN 752:2008, 2008 Entwässerungssysteme außerhalb vo Gebäuden - Kanalmanagement. Zeitschrift 3R, Fachzeitschrift für sicher und effiziente Rohrleitungssysteme Handbuch für den Rohrleitungsbau Ban 1 und 2, 4. Auflage, Günter Wossog, 201 Rohrleitungstechnik, Walter Wagner	
	9	Stein D., Stein R., "Instandhaltung vo Kanalisationen", 1008 S., ISBN 978-3 9810648-4-1   Verlag Prof. DrIng. Stein & Partner GmbH, 2014 Stein, D., "Grabenloser Leitungsbau", 2 Auflage, Gebundene Ausgabe - 116 Seiten, Ernst & Sohn Verlag, 2003, ISBN	

11	₩หือใช้หือใช้ 6D: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 3-89999-027-7, 227 Seiten, 2012

Course L2006: Simulation of sewerage systems		
Тур	Seminar	
Hrs/wk	3	
СР	3	
<b>Workload in Hours</b>	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Ralf Otterpohl	
Language	EN	
Cycle	WiSe	
Content	<ul> <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		

Module M0874	1: Wastewater Systems			
Courses				
<b>Title</b> Wastewater Systems -	Collection, Treatment and Reuse (L0934)	Typ Lecture	Hrs/wk	<b>CP</b> 2
Wastewater Systems -	Collection, Treatment and Reuse (L0943)	Recitation (large)	Section 1	1
Advanced Wastewater	Treatment (L0357)	Lecture Recitation	2 Section	2
Advanced Wastewater	Treatment (L0358)	(large)	Section 1	1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
	Knowledge of wastewater managem wastewater treatment.	ent and the	key processes	involved ir
Educational Objectives	After taking part successfully, students	have reached t	the following learr	ning results
Professional Competence				
Knowledge	Students are able to outline key areas of the full range of treatment systems in waste water management, as well as their mutual dependence for sustainable water protection. They can describe relevant economic, environmental and social factors.			
Skills	Students are able to pre-design and explain the available wastewater treatment processes and the scope of their application in municipal and for some industrial treatment plants.			
Personal Competence				
Social Competence	Social skills are not targeted in this mod	dule.		
Autonomy	Students are in a position to work on a subject and to organize their work flow independently. They can also present on this subject.			
Workload in Hours	Independent Study Time 96, Study Time	e in Lecture 84		
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following Curricula	Civil Engineering: Specialisation Structure Civil Engineering: Specialisation Geotec Civil Engineering: Specialisation Coasta Civil Engineering: Specialisation Water and Bioprocess Engineering: Specialisation Compulsory Energy and Environmental Engineering: Elective Compulsory Environmental Engineering: Specialisation Elective Compulsory Environmental Engineering: Specialisation Environmental Engineering: Elective Colliternational Management and Engineering: Elective Colliternational Management and Engineering Elective Colliternational Management and Engineering Elective Colliternational Management and Engineering Elective Colliternational Management Elective Compulsory	hnical Enginee I Engineering: E and Traffic: Cor A - General Bic g: Specialisatio fon Water: Elect gineering: Spe mpulsory ering: Specialis	ring: Elective Com Elective Compulso mpulsory oprocess Engineer n Environmental tive Compulsory ecialisation II. I	npulsory ory ring: Elective Engineering Energy and

Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory
Process Engineering: Specialisation Process Engineering: Elective Compulsory
Water and Environmental Engineering: Specialisation Water: Compulsory
Water and Environmental Engineering: Specialisation Environment: Elective Compulsory
Water and Environmental Engineering: Specialisation Cities: Compulsory

Course L0934: Was	Course L0934: Wastewater Systems - Collection, Treatment and Reuse		
Тур	Lecture		
Hrs/wk	2		
СР	2		
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Ralf Otterpohl		
Language	EN		
Cycle	SoSe		
Content	<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
<b>Workload in Hours</b>	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: Adv	anced Wastewater Treatment		
Тур	Lecture		
Hrs/wk	Hrs/wk 2		
СР	<b>CP</b> 2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Dr. Joachim Behrendt		
Language			
Cycle	SoSe		
	Survey on advanced wastewater treatment		
	reuse of reclaimed municipal wastewater		
	Precipitation		
	Flocculation		
Comtont	Depth filtration		
Content	Membrane Processes		
	Activated carbon adsorption		
	Ozonation		
	"Advanced Oxidation Processes"		
	Disinfection		
	Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003		
	Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987		
Literature	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	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Joachim Behrendt	
Language		
Cycle	SoSe	
	Aggregate organic compounds (sum parameters)	
	Industrial wastewater	
	Processes for industrial wastewater treatment	
	Precipitation	
Content	Flocculation	
	Activated carbon adsorption	
	Recalcitrant organic compounds	
	Metcalf & Eddy, Wastewater Engineering: Treatment and Reuse, McGraw-Hill, Boston 2003	
	Wassertechnologie, H.H. Hahn, Springer-Verlag, Berlin 1987	
Literature	Membranverfahren: Grundlagen der Modul- und Anlagenauslegung, T. Melin und R. Rautenbach, Springer-Verlag, Berlin 2007	
	Trinkwasserdesinfektion: Grundlagen, Verfahren, Anlagen, Geräte, Mikrobiologie, Chlorung, Ozonung, UV-Bestrahlung, Membranfiltration, Qualitätssicherung, W. Roeske, Oldenbourg-Verlag, München 2006	
	Organische Problemstoffe in Abwässern, H. Gulyas, GFEU, Hamburg 2003	

Courses				
Title		Тур	Hrs/wk	СР
Noise Protection (L110	9)	Lecture	2	2
Urban Infrastructures (	(L0874)	Project-/problem- based Learning	2	4
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	LNODE	None		
Recommended Previous Knowledge	Knowledge on measures for	climate protection		
Educational Objectives	LATTAR TAKING NART CLICCASSTILLIV STILG	ents have reached the fol	lowing learn	ing results
Professional Competence				
Knowledge	Students can describe urban development corridors as well as current and future urban environmental problems. They are able to 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 urban life. They can, for example, derive and discuss measures for effective noise abatement.			
Skills	Students are able to develop specific solutions for correcting existing or future environment-related problems of urban development. They can define a range of conceptual and technical solutions for environmental problems for different development paths. To solve specific urban environmental problems they can select technical innovations and integrate them into the urban 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 for presentations and contributions to the discussions. They can acquire appropriate knowledge by making enquiries independently.			
Workload in Hours	Independent Study Time 124, Stud	y Time in Lecture 56		
Credit points	6			
Course achievement	INODE			
	Written elaboration			
Examination duration and scale	Written Report plus oral Presentation			
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Environmental Engineering: Core qualification: Elective Compulsory Joint European Master in Environmental Studies - Cities and Sustainability: Core qualification: Compulsory Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Elective			

Compulsory Water and Environmental Engineering: Specialisation Cities: Compulsory

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

Course 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.

Module M0703	3: Soil and Groundwater Cor	ntamination		
Courses				
<b>Title</b> Contamination and Re NAPL in Soil and Groun	ndwater (L0545)	<b>Typ</b> Project Seminar Lecture Recitation Sect	Hrs/wk 3 1	<b>CP</b> 3 1
NAPL in Soil and Grour	ndwater (L0546)	(small)	2	2
Module Responsible	NN			
Admission Requirements	None			
Recommended Previous Knowledge	Geohydraulic and solute transport			
Educational Objectives	After taking part successfully, students h	nave reached the fol	llowing learn	ing results
Professional Competence	The students are able to analyse contanable to create remediation concepts for			
Knowledge	The same of the sa			
Skills	The students are able to analyse contaminations in soils and groundwater using special engineering methods. They can do transport modelling in the unsaturated zone, estimations of groundwater pollution and analyse the impacts of remediation measures. They can forecast die distribution, mobility and remediation of non aquaous phase liquids in soil and groundwater.			
Personal Competence				
Social Competence	The students are able to prepare compare able to find remediation measures.	lex contamination	issues in tea	amwork and
Autonomy				
	Independent Study Time 96, Study Time	in Lecture 84		
Credit points Course				
achievement	None			
Examination	Written exam			
Examination duration and scale	Klausur 60 min; Referat 15 min;			
the Following	Civil Engineering: Specialisation Water al Water and Environmental Engineering: S Water and Environmental Engineerir Compulsory Water and Environmental Engineering: S	pecialisation Water ng: Specialisation	: Elective Co Environmer	nt: Elective

Course L0547: Contamination and Remediation	
Тур	Project Seminar
Hrs/wk	3
СР	3
<b>Workload in Hours</b>	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Wilfried Schneider
Language	DE
Cycle	SoSe
Content	Processing of a complex soil and groundwater contamination site. Students perform analyses of data to detect the contamination and to analyse the groundwater hazard and to develop a concept for remediation of the damage.
Literature	entfällt

Course L0545: NAPL in Soil and Groundwater		
Тур	Lecture	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Wilfried Schneider	
Language	DE	
Cycle	SoSe	
Content	concept of capillarity, multi phase distribution in poraus media, residual saturation, rellative permeability, infiltration of NAPL into the subsurface, vertical distribution of LNAPL, specific volume	
Literature	Charbeneau, R.J. (2000): Groundwater Hydraulics and pollutant Transport	

Course L0546: NAPL in Soil and Groundwater	
Тур	Recitation Section (small)
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Wilfried Schneider
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Module M135	L: Construction Proces	sses		
Courses				
<b>Title</b> Digital Building (L1908 Lean Construction (L1908 System Dynamics (L1908)	910)	<b>Typ</b> Lecture Lecture Lecture	<b>Hrs/wk</b> 2 2 2	<b>CP</b> 2 2 2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, s	After taking part successfully, students have reached the following learning results		
Professional Competence				
Knowledge Skills				
Personal Competence				
Social Competence Autonomy				
<b>Workload in Hours</b>	Independent Study Time 96, St	udy Time in Lecture 84		
Credit points	6			
Course achievement	None			
<b>Examination</b>	Written exam			
Examination duration and scale	60 min			
Assignment for the Following Curricula	Civil Engineering: Specialisation Civil Engineering: Specialisation Civil Engineering: Specialisation Civil Engineering: Specialisation	n Geotechnical Engineerin n Structural Engineering: E	g: Elective Com Elective Compul	pulsory

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

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

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

Module M087	L: Hydrological Systems			
6				
Courses				_
<b>Title</b> Applied Surface Hydro	logy (L0280)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 2
		Project-/problem-	_	
Applied Surface Hydro	logy (L1412)	based Learning	1	2
Interaction Water - En	vironment in Fluvial Areas (L0295)	Project-/problem- based Learning	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous Knowledge	Fundamentals of Hydromechanics and H I and Hydraulic Engineering II	lydraulic Engineering:	Hydraulic	Engineering
Educational Objectives	After taking part successfully, students h	nave reached the follo	owing learn	ing results
Professional Competence				
Knowledge	The students are able to define the basic concepts of hydrology and water management. They are able to describe and quantify the relevant processes of the			
Skills	The students are able to use the basic hydrological concepts and approaches and are able to theoretically derive established reservoir / storage models or a unit-hydrograph as the basis for rainfall-run-off-models. The student are able to explain the basic concepts of measurements of hydrological and hydrodynamic values in nature and are able to perform, analyze and statistically assess these measurements. Furthermore, they are able to apply a hydrological model to basic hydrological problems.			
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in applied problems of the hydrology and water management. 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 problems			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	The duration of the examination is 90 respect to the general understanding of			
Assignment for the Following Curricula	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Environmental Engineering: Core qualification: Elective Compulsory Joint European Master in Environmental Studies - Cities and Sustainability: Core qualification: Compulsory Water and Environmental Engineering: Specialisation Water: Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Elective Compulsory Water and Environmental Engineering: Specialisation Cities: Elective Compulsory			

Course L0289: Applied Surface Hydrology		
Тур	Lecture	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Peter Fröhle	
Language	DE/EN	
Cycle	SoSe	
Content	<ul> <li>Basics of hydrology:</li> <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://de.wikipedia.org/wiki/Kalypso_(Software) http://kalypso.bjoernsen.de/ http://sourceforge.net/projects/kalypso/	

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

Course L0295: Interaction Water - Environment in Fluvial Areas		
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	2	
<b>Workload in Hours</b>	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	-	

Module M087	5: Nexus Engineering - Wa	ter, Soil, Fo	od and Ene	rgy
Courses				
Title		Typ	Hrs/wk	СР
Ecological Town Desig	n - Water, Energy, Soil and Food Nexus	<b>Typ</b> Seminar	7 2	2
(L1229) Water & Wastewater S	Systems in a Global Context (L0939)	Lecture	2	4
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
	Basic knowledge of the global situmigration to cities, lack of water resou			degradation
Educational Objectives	After taking part successfully, students	s have reached th	e following learr	ing results
Professional Competence				
Knowledge	Students can describe the facets of the global water situation. Students can judge			
Skills	Students are able to design ecological settlements for different geographic and socio-economic conditions for the main climates around the world.			
Personal Competence				
Social Competence	The students are able to develop a specific topic in a team and to work out milestones according to a given plan.			
Autonomy	Students are in a position to work on a subject and to organize their work flow independently. They can also present on this subject.			
Workload in Hours	Independent Study Time 124, Study Ti	ime in Lecture 56		
Credit points	6			
Course achievement	LNODE			
Examination	Subject theoretical and practical work			
duration and	During the course of the semester, the includes presentations and papers. beginning of the smester in the StudIP	Detailed informa	ation can be fo	
the Following	Civil Engineering: Specialisation Water Bioprocess Engineering: Specialisation Compulsory Chemical and Bioprocess Engineering Elective Compulsory Environmental Engineering: Core qualification: Compulsory Process Engineering: Specialisation I Compulsory Process Engineering: Specialisation Process Engineering: Speciali	n A - General Biop :: Specialisation G ification: Elective ntal Studies - Cit Environmental Pr ocess Engineering : Specialisation W ering: Specialisat	General Process Compulsory ies and Sustain ocess Engineeri g: Elective Compulater: Elective Coion Environmen	Engineering ability: Core ng: Elective ulsory mpulsory nt: Elective

Course L1229: Ecological Town Design - Water, Energy, Soil and Food Nexus		
Тур	Seminar	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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	
СР	4	
<b>Workload in Hours</b>	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 City Planning (L1066)		<b>Typ</b> Project-/problem-	Hrs/wk	<b>CP</b> 6
		based Learning		
Module Responsible	Prof. Carsten Gertz			
Admission Requirements	None			
	for "Principles of Urban Planning": no	ne		
Previous	for "Designing Urban Streetscapes" through taking the undergradua Engineering"			
Educational Objectives	After taking part successfully, studer	ts have reached the foll	owing learn	ing results
Professional				
Competence	Students are able to:			
Knowledge	<ul> <li>use technical terms of urban p</li> <li>describe the main determinan</li> <li>explain and compare different influenced.</li> <li>discuss requirements for public explain the importance of street</li> </ul>	ts of urban development possibilities of how urb c streetscapes.		ment can k
Skills	Students are able to:  • read and analyze urban devel • appraise such concepts in the • design, justify and reflect thei	context of competing re	quirements	j.
Personal Competence	Students are able to:			
Social Competence	<ul> <li>discuss intermediate results w</li> <li>constructively accept feedbac</li> <li>provide constructive feedback</li> </ul>	k on their own work.		
Autonomy	<ul> <li>Students are able to:</li> <li>independently complete a v broadly pre-defined process.</li> <li>assess the consequences of the independently acquire knowled areas.</li> </ul>	eir proposed solutions.		
Newlelead in Harre	Independent Study Time 124, Study	T' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' ' '		

Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and scale	written assignment, designwork during the semester
Assignment for the Following Curricula	Logistics, intrastructure and Mobility: Specialisation intrastructure and Mobility:

Course L1066: City Planning		
Typ Project-/problem-based Learning		
Hrs/wk		
CP		
	Independent Study Time 124, Study Time in Lecture 56	
	Prof. Carsten Gertz	
Language		
Cycle		
Content	"Principles of Urban Planning" deals with the determinants of urban development and their interactions. Topics include:  • legal framework, • instruments and methods of planning, • functional requirements, • stakeholders and actors • basic design requirements • different planning levels and • historical contexts.  The objective of the course is for students to acquire a basic understanding of urban development problems and approaches for solving them. They will also be able to comprehend the process of urban planning. The course also covers the various functional and aesthetic requirements for designing streetscape as the most important elements of public space.  The project work deals with a real life scenario and includes drawing up a development plan, an urban design concept, a building masterplan and a street redesign.	
Literature	Albers, Gerd; Wekel, Julian (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.	

Module M0977	7: Construction Logistics	and Project	Manageme	ent
Courses				
<b>Title</b> Construction Logistics	(L1163)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 2
Construction Logistics	(L1164)	Recitation (small)	Section 1	2
Project Development a	nd Management (L1161)	Lecture	1	1
Project Development a	nd Management (L1162)	Project-/proble based Learning		1
Module Responsible	Prof. Heike Flämig			
Admission Requirements	None			
Recommended Previous Knowledge	none			
Educational Objectives	After taking part successfully, stud	ents have reached th	ne following lea	rning results
Professional Competence	Students can			
Knowledge	<ul> <li>give definitions of the main terms of construction logistics and project development and management</li> <li>name advantages and disadvantages of internal or external construction logistics</li> <li>explain characteristics of products, demand and production of construction objects and their consequences for construction specific supply chains</li> <li>differentiate constructions logistics from other logistics systems</li> </ul>			
Skills	<ul> <li>carry out project life cycle assessments</li> <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> <li>design supply and waste removal concepts for a construction project</li> </ul>			
Personal Competence	Students can			
Social Competence	<ul> <li>hold presentations in and for</li> <li>apply methods of conflict so</li> </ul>		work and case s	tudies
Autonomy	Students can  • solve problems by holistic, systemic and flow oriented thinking  • improve their creativity, negotiation skills, conflict and crises solution skill by applying methods of moderation in case studies			
Workload in Hours	Independent Study Time 124, Stud	y Time in Lecture 56	j	
Credit points	6			
Course achievement	None			
	Written elaboration			
Examination	Two written papers with presentati	ons		

scale	
Assignment for the Following Curricula	

Course L1163: Construction Logistics			
Тур	Lecture		
Hrs/wk	1		
СР	2		
<b>Workload in Hours</b>	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:		
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 Logistics		
Тур	Recitation Section (small)	
Hrs/wk	1	
СР	2	
<b>Workload in Hours</b>	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: Proj	ect Development and Management
Тур	Lecture
Hrs/wk	1
СР	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei
Language	DE
Cycle	SoSe
Content	<ul> <li>Within the lecture, the main aspects of project development and management are tought:</li> <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 Development and Management		
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0998: Statics and Dynamics of Structures				
Courses				
Title		Тур	Hrs/wk	СР
Structural Dynamics (L		Lecture Recitation	2 Section <sub>2</sub>	2
Structural Dynamics (L	.1203)	(large)	2	2
Fracture mechanics ar	nd fatigue in steel structures (L0564)	Lecture Recitation	1 Section	1
Fracture Mechanics an	d Fatigue (L0565)	(large)	Section 1	1
Module Responsible	I Prof I I WA Starossak			
Admission Requirements	None			
Recommended	Knowledge of linear structural analystructures; Mechanics I/II, Mathemat			determinat
Educational Objectives	After taking part successfully, stude	nts have reached	the following learr	ning results
Professional Competence				
Competence	After successful completion of thi aspects of dynamic effects on struct			n the basi
		ures and the resp	ective methods.	
Knowledge				
Skills	After successful completion of this response of material and structur computational approaches and meti	es to dynamics I		
Personal Competence	Students can			
Social Competence	<ul> <li>participate in subject-specific</li> <li>defend their own work results</li> <li>promote the scientific develo</li> <li>Furthermore, they can give a</li> </ul>	in front of others pment of colleague	es	criticism
Autonomy	Students are able to gain knowled sources and apply it to new proble solution process for problems in the	ms. Furthermore, t	they are able to s	
Workload in Hours	Independent Study Time 96, Study	Fime in Lecture 84		
Credit points	6			
Course achievement	INONE			
	J Written exam			
Examination duration and scale				
	Civil Engineering: Specialisation Stru	uctural Engineering	g: Compulsory	

Assignment for the Following Curricula

Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory
Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
Civil Engineering: Specialisation Water and Traffic: Elective Compulsory
International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory

Course L1202: Stru	ictural Dynamics
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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> progressive collapse
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	
<b>Workload in Hours</b>	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	

Course L0564: Fracture mechanics and fatigue in steel structures		
Тур	Lecture	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Ingo Hadrych	

Language	DE				
Cycle	SoSe				
	<ul> <li>basics of fatigue stress and fatigue resistance and determination of fatigue strength,</li> </ul>				
	determination anduse of S-N-curves and classification of notch effects,				
	<ul> <li>set up of determination of fatigue strength under dynamic load using the accumulation formula by Palmgren-Miner,</li> </ul>				
Content	• set up of determination of fatigue strength in different examples,				
	• basics of construction and design regarding the problem of material fatigue,				
	basics of linear elastic fracture mechanics under static and dynamic load,				
	<ul> <li>determination of lifetime of steel construction based on linear elastic fracture mechanics in different examples.</li> </ul>				
	<ul> <li>Seeßelberg, C.; Kranbahnen - Bemessung und konstruktive Gestaltung; 3.</li> <li>Auflage; Bauwerk-Verlag; Berlin 2009</li> </ul>				
	<ul> <li>Kuhlmann, Dürr, Günther; Kranbahnen und Betriebsfestigkeit; in Stahlbau Kalender 2003; Verlag Ernst &amp; Sohn; Berlin 2003</li> </ul>				
	<ul> <li>Deutscher Stahlbau-Verband (Hrsg.); Stahlbau Handbuch Band 1 Teil B; 3.</li> <li>Auflage; Stahlbau-Verlagsgesellschaft; Köln 1996</li> </ul>				
	• 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 Bemessungsregeln, Bemessungsregeln für den Hochbau; 1993</li> <li>DIN V ENV 1993-6: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 6: Kranbahnen; 2001</li> </ul>				
Literature	<ul> <li>DIN-Fachbericht 126. Richtlinie zur Anwendung von DIN V ENV 1993-6;</li> <li>Nationales Anwendungsdokument (NAD); Berlin 2002</li> </ul>				

Course L0565: Fracture Mechanics and Fatigue		
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Ingo Hadrych	
Language	DE	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0593: Building Materials and Building Preservation					
Courses					
Title Repair of Structures (L0255) Mineral Building Materials (L0253)		Typ Lecture Lecture	Hrs/wk 1 2	<b>CP</b> 1 2	
Technology of mineral Building Materials (L0256)		Project-/problem-	1	2	
Transport Processes in Building Materials and Damage Processes (L0254)  based Learning  Lecture 1 1					
Module Responsible	Prof. Frank Schmidt-Döhl				
Admission Requirements	None				
Recommended Previous Knowledge	for example by the modules Principles	Basic knowledge about building materials, building physics and building chemistry, for example by the modules Principles of Building Materials and Building Physics and Building Materials and Building Chemistry.			
Educational Objectives	After taking part successfully, students h	nave reached the follo	owing learn	ing results	
Professional Competence					
Knowledge	The students are able to describe the components of mineral building materials and their function in detail and to use them for the manufacture of special mineral building materials. They are able to show the characteristics of mineral building materials. They are able to describe the manufacture, properties and fields of application of special mortars and special concretes and the correlations of their material parameters. They are able to show the principles of anchor technology and design.				
Skills	The students are able to perform an optimization of granulometry of a mineral building material. They are able to design a special mineral mortar and to manufacture this mortar. The students are able to manufacture post installed rebar connections. They are able to recognize damages, to assess possible causes, to use the fundamentals of construction preservation and to select repair and strengthening measures.				
Personal Competence Social Competence	The students are able to develop in small grous the mixture of a special mortar. They present their results to the lecturer and the other students. In a critical discussion they defend and adjust their results. The students are able to manufacture their special building material on the basis of this feedback.				
Autonomy	The students are able to responsibly equipment for their project and to invest				
	Independent Study Time 110, Study Tim	e in Lecture 70			
Credit points					
Course achievement	Yes 20 % Form Subject theorem practical work	<b>Descrip</b> etical and	tion		
Examination	•				
Examination duration and scale					

Assig	nment	foi
the	<b>Follow</b>	ing
	Curric	ula

Civil Engineering: Specialisation Geotechnical Engineering: Compulsory
Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
Civil Engineering: Specialisation Water and Traffic: Elective Compulsory

Course L0255: Repair of Structures			
Тур	Lecture		
Hrs/wk	1		
СР	1		
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Frank Schmidt-Döhl		
Language	DE		
Cycle			
	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		
<b>Workload in Hours</b>	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	
<b>Workload in Hours</b>	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	
	Taylor, H.F.W.: Cement Chemistry	
Literature	Springenschmid, R.: Betontechnologie für die Praxis	

Course L0254: Transport Processes in Building Materials and Damage Processes		
Тур	Lecture	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	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	

Module M0982	2: Transportation Modelling			
Courses				
Title		Тур	Hrs/wk	СР
Transportation Modelli	ng (L1180)	Project-/problem- based Learning	4	6
Module Responsible	I Prof. Careron Gorra			
Admission Requirements	INODE			
	some knowledge of transport planning, e "Transport Planning and Traffic Engineer		e undergra	iduate class
Educational Objectives		ave reached the follo	wing learn	ing results
Professional Competence				
Knowledge	Students are able to understand the transport models.	Students are able to understand the operation and potential applications of transport models.		
Skills	<ul> <li>• use travel demand modelling software packages for solving practical problems.</li> <li>• design a database structure for travel demand models.</li> <li>• assess modelling results.</li> <li>• appraise potential applications and limitations of such models.</li> </ul>			
Personal Competence				
•	Students are able to independently deve Students are able to:	lop and document sol	utions.	
Autonomy	<ul> <li>independently organise, manage and solve set tasks.</li> <li>independently prepare written reports.</li> </ul>			
Workload in Hours	I Independent Study Time 124, Study Time	e in Lecture 56		
Credit points	6			
Course achievement	INONA			
Examination	Written elaboration			
Examination duration and scale	written assignment with presentation du	ring the semester		
Assignment for the Following Curricula	Logistics, intrastructure and Mobility: S	Specialisation Infrast	ructure ar	-

Course L1180: Tran	nsportation Modelling
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
<b>Workload in Hours</b>	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.

Module M07 Technology	49: Waste Treatment and Solid Matter Process		
Courses			
<b>Title</b> Solid Matter Process To Thermal Waste Treatm Thermal Waste Treatm	Recitation Section		
Module Responsible	Prof Kerstin Kuchta		
Admission Requirements	None		
Recommended Previous Knowledge	thermo dynamics     fluid dynamics		
Educational Objectives	TAILEL LAKING DALI SUCCESSIUNV. SIUGENIS NAVE LEACHED THE TONOWING TEATHING LESUNS		
Professional Competence			
Knowledge	waste treatment and particle process engineering and contemplate them in the context of their field.  The industrial application of unit operations as part of process engineering is explained by actual examples of waste incineration technologies and solid biomass processes. Compostion, particle sizes, transportation and dosing, drying and agglomeration of renewable resources and wastes are described as important unit operations when producing solid fuels and bioethanol, producing and refining edible oils, electricity, heat and mineral recyclables.		
Skills	The students are able to select suitable processes for the treatment of wastes or raw material with respect to their characteristics and the process aims. They can evaluate the efforts and costs for processes and select economically feasible treatment concepts.		
Personal Competence			
Social Competence	<ul> <li>respectfully work together as a team and discuss technical tasks</li> <li>participate in subject-specific and interdisciplinary discussions,</li> <li>develop cooperated solutions</li> <li>promote the scientific development and accept professional constructive criticism.</li> </ul>		
Autonomy	Students can independently tap knowledge of the subject area and transform it to new questions. They are capable, in consultation with supervisors, 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 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	None		

Examination	Written exam
Examination duration and scale	120 min
the Following	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Bioprocess Engineering: Specialisation A - General Bioprocess Engineering: Elective Compulsory Energy and Environmental Engineering: Specialisation Energy and Environmental Engineering: Elective Compulsory International Management and Engineering: Specialisation II. Process Engineering and Biotechnology: Elective Compulsory International Management and Engineering: Specialisation II. Renewable Energy: Elective Compulsory Renewable Energies: Specialisation Bioenergy Systems: Elective Compulsory Process Engineering: Specialisation Chemical Process Engineering: Elective Compulsory Process Engineering: Specialisation Process Engineering: Elective Compulsory Process Engineering: Specialisation Environmental Process Engineering: Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Compulsory Water and Environmental Engineering: Specialisation Cities: Elective Compulsory

Course L0052: Soli	Course L0052: Solid Matter Process Technology for Biomass		
Тур	Lecture		
Hrs/wk	2		
СР	2		
<b>Workload in Hours</b>	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, ransportation and dosing, drying and agglomeration of renewable resources are lescribed 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: The	Course L0320: Thermal Waste Treatment	
Тур	Lecture	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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: The	Course L1177: Thermal Waste Treatment	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	2	
<b>Workload in Hours</b>	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	

Courses					
Title Groundwater Modeling	using Modflow (L0543)	<b>Typ</b> Lecture		Hrs/wk	<b>CP</b>
Groundwater Modeling using Modflow (L0543) Groundwater Modeling using Modflow (L0544)			Section	-	2
Modeling of Water Sup	ply and Sewer Network (L0875)	Project-/probler based Learning		2	3
Module Responsible	Dr. Klaus Johannsen				
Admission Requirements	None				
	Groundwater				
	• groundwater hydraulics and	transport of substan	ces		
Recommended	Pipe Systems				
Previous Knowledge	<ul> <li>Knowledge on urban water infrastructures, in particular drinking water systems and urban drainage systems including 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, stud	ents have reached th	ne follov	ving learn	ing result
Professional Competence					
	The students are able to describe the modelling of groundwater flow and transpo as well as urban water infrastructures. They can carry out systems analyses and ca detect technical and conceptual weak points within the systems in case studies. Besides they are able to analyse interdependencies of hydraulic and tox phenomena in soil and water.				
	The students are able to construct and apply scientific groundwater mode indipendently. They can work on different scenarios and can compare or asses different solutions for existing problems by application of selected softwar products. The students are able to use different software solutions (e.g. EPANET EPA-SWMM).				
Personal Competence					
Social Competence	Wird nicht vermittelt.				
Autonomy	Wird nicht vermittelt.				
Workload in Hours	Independent Study Time 110, Stud	y Time in Lecture 70			
1					
Credit points					
Course	None				
Course	Oral exam				



Course L0543: Gro	Course L0543: Groundwater Modeling using Modflow		
Тур	Lecture		
Hrs/wk	1		
СР	1		
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Sonja Götz (geb. Schröter)		
Language	DE/EN		
Cycle	SoSe		
	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: Gro	Course L0544: Groundwater Modeling using Modflow	
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Sonja Götz (geb. Schröter)	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Course L0875: Mod	Course L0875: Modeling of Water Supply and Sewer Network			
Тур	Project-/problem-based Learning			
Hrs/wk	2			
СР	3			
<b>Workload in Hours</b>	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	D: Management of Surface W	/ater			
Courses					
Title		Тур	Hrs/wk	СР	
_	vers and Estuaries (L0810) aulic Engineering / Integrated Flood Protection	Lecture Project-/problem- based Learning	2	2	
Module Responsible	Prof. Peter Fröhle				
Admission Requirements	None				
Recommended Previous Knowledge	rundamentals of Hydromechanics,	Fundamentals of Hydromechanics, Hydraulics, Hydrology and Hydraulic Engineering; Hydraulic Engineering I and Hydraulic Engineering II			
Educational Objectives	After taking part successfully, students h	ave reached the follo	wing learn	ing 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 flows and waves. They can also depict the concepts of nature oriented hydraulic engineering.				
Skills	Students are able to apply hydrodynamic-numerical models to practical hydraulic engineering tasks. Furthermore, the students are able to set up flood-risk management concepts and are able to apply basic concepts of renaturation to practical problems.				
Personal Competence					
Social Competence	The students are able to deploy their gained knowledge in applied problems of the practical nature-based hydraulic engineering. 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 problems.				
Workload in Hours	Independent Study Time 110, Study Time	e in Lecture 70			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and scale	The duration of the examination is 150 respect to the general understanding of t				
the Following	Civil Engineering: Specialisation Water ar Environmental Engineering: Core qualific Joint European Master in Environmenta qualification: Compulsory Water and Environmental Engineering: S Water and Environmental Engineering: S Water and Environmental Engineering: S	ation: Elective Compu I Studies - Cities an pecialisation Water: C pecialisation Environr	ulsory Id Sustaina Compulsory ment: Com	, pulsory	

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	DE/EN
Cycle	SoSe
Content	<ul> <li>classification of models</li> <li>model concept</li> <li>modelling</li> <li>1D Working Equation</li> <li>Mathematical description of physical processes</li> <li>Equation of motions</li> <li>conservation of mass</li> <li>conservation of momentum</li> <li>Initial conditions and boundary conditions</li> <li>Numerical Methods</li> <li>Time step procedure</li> <li>Finite differences</li> <li>Finite volumes</li> </ul>
Literature	Vorlesungsskript

Course L0961: Nati	ure-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	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

Module M0860: Harbour Engineering and Harbour Planning				
Courses				
<b>Title</b> Harbour Engineering (I	L0809)	<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 2
Harbour Engineering (I	L1414)	Project-/problem- based Learning	1	2
Port Planning and Port	Construction (L0378)	Lecture	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
Recommended Previous Knowledge	Basics of coastal engineering			
Educational Objectives	After taking part successfully, stude	nts have reached the fol	lowing learn	ing results
Professional Competence				
Knowledge	The students are able to define in details and to choose design approaches for the functional design of a port and apply them to design tasks. They can design the fundamental elements of a port.			
Skills	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. 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 problems.			
<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Course achievement	None			
Examination	Written exam			
Examination duration and scale	The duration of the examination is 150 min. The examination includes tasks with respect to the general understanding of the lecture contents and calculations tasks.			
Assignment for the Following Curricula	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective 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 Theoretical Mechanical Engineering: Technical Complementary Course: Elective Compulsory			

Course L0809: Harbour Engineering		
Тур	Lecture	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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 Engineering	
Тур	Project-/problem-based Learning
Hrs/wk	1
СР	2
<b>Workload in Hours</b>	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	SoSe
Content	See interlocking course
Literature	See interlocking course

Course L0378: Port	Planning and Port Construction
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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

Module M085	7: Geochemical Engine	ering		
Courses				
Title		Тур	Hrs/wk	СР
Contaminated Sites an	nd Landfilling (L0906)	Lecture	2	2
Contaminated Sites ar	nd Landfilling (L0907)	Recitation (large)	Section 1	2
Geochemical Engineer	ing (L0904)	Lecture	2	2
Module Responsible	Dr. Marco Ritzkowski			
Admission Requirements	None			
	Module: General and Inorganic C	Chemistry,		
Recommended	Module:Organic Chemistry,			
Previous	Biology (Basic Knowledge)			
1	,			
Educational Objectives	After taking part successfully, st	udents have reached t	the following learn	ning results
Professional				
Competence			ina muafaad le	
Knowledge	With the completion of this module students acquire profound knowledge of biogeochemical processes, the fate of pollutants in soil and groundwater, and techniques to deposit contaminated waste material. They are able to describe in principle the behaviour 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 and critically assess the situation technically and conceptually. They are able to draw comparisons on different remediation strategies and techniques. Model projects can be devised and treated.			
Personal Competence				
Social Competence	Students can discuss technical and scientific tasks within a seminar subject specificand interdisciplinary .			
Autonomy	Students can independently exploit sources, acquire the particular knowledge of the subject and apply it to new problems.			
<b>Workload in Hours</b>	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Course achievement	LNONA			
Examination	Written exam			
Examination duration and scale				
Assignment for the Following Curricula	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Environmental Engineering: Core qualification: Elective Compulsory Water and Environmental Engineering: Specialisation Water: Elective Compulsory			

Course L0906: Contaminated Sites and Landfilling		
Тур	Lecture	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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	1) Waste Management. Bernd Bilitewski; Georg Härdtle; Klaus Marek (Eds.), ISBN: 9783540592105, Springer Verlag Lehrbuchsammlung der TUB, Signatur USH-305  2) Solid Waste Technology and Management. Thomas Christensen (Ed.), ISBN: 978-1-4051-7517-3, Wiley Verlag Lesesaal 2: US - Umweltschutz, Signatur USH-332  3) Natural attenuation of fuels and chlorinated solvents in the subsurface. Todd H. Wiedemeier(Ed.), ISBN: 0471197491  Lesesaal 2: US - Umweltschutz, Signatur USH-844	

Course L0907: Contaminated Sites and Landfilling	
Тур	Recitation Section (large)
Hrs/wk	1
СР	2
<b>Workload in Hours</b>	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	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Joachim Gerth	
Language	EN	
Cycle	SoSe	
Content	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	<b>Geochemistry, groundwater and pollution.</b> C. A. J. Appelo; D. Postma Leiden [u.a.] Balkema 2005 Lehrbuchsammlung der TUB, Signatur GWC-515	

Module M0705	5: Groundwater			
Courses				
Title		Typ	Hrs/wk	СР
Geohydraulic and Solu	te Transport (L0539)	<b>Typ</b> Lecture	nrs/wk 2	2
Geohydraulic and Solu		Recitation	Section 1	1
-	ater Hydrology (L0541)	(small) Lecture	1	1
	ater Hydrology (L0542)	Recitation	Section 2	2
- Simulation in Groundw	dici flydrology (20042)	(small)	-	
Module Responsible	NN			
Admission Requirements	None			
Recommended Previous Knowledge	<ul><li> Ground water hydrology</li><li> Hydromechanics</li></ul>			
Educational Objectives	After taking part successfully, studer	nts have reached	the following learn	ing results
Professional Competence				
Knowledge	The students are able to describe the fate of solutes in the subsurface along the path between soil and water body quantitatively and qualitatively. They are able to do this with simulation models.			
Skills	The students are able to describe conceptually movement and storage of water in the unsaturated zone. They are able to analyse pF- functions and Ku functions. They can model transport of solutes in the unsaturated and saturated zoned. They are able to determine dispersiities, sorption coefficients, decay rates and dissolution rates for organic and inorganic substances.			
Personal Competence				
Social Competence	The students can help to each other.			
Autonomy	none			
	Independent Study Time 96, Study T	ime in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and scale	60 min written exam and written pap	oers		
the Following	Civil Engineering: Specialisation Stru Civil Engineering: Specialisation Geo Civil Engineering: Specialisation Coar Civil Engineering: Specialisation Wat Process Engineering: Specialisation Compulsory Process Engineering: Specialisation F Water and Environmental Engineering Water and Environmental Engineering Compulsory Water and Environmental Engineering	technical Engineerstal Engineerstal Engineering: er and Traffic: Ele Environmental Process Engineering: Specialisation eering: Specialis	ering: Elective Com Elective Compulso ective Compulsory Process Engineeri ng: Elective Compu Water: Compulsory ation Environmer	pulsory ry ng: Elective ulsory y nt: Elective

Course L0539: Geohydraulic and Solute Transport		
Тур	Lecture	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Wilfried Schneider	
Language	DE	
Cycle	WiSe	
Content	Pump test analysis, water content-water suction functions, unsaturated hydraulic conductivity function, Brooks-Corey relation, van Genuchten relation, solute transport in unsaturated zone, solute transport and reactions in groundwater	
Literature	Todd; K. (2005): Groundwater Hydrology  Fetter, C.W. (2001): Applied Hydrogeology  Hölting & Coldewey (2005): Hydrogeologie  Charbeneau, R.J. (2000): Groundwater Hydraulics and pollutant Transport	

Course L0540: Geohydraulic and Solute Transport	
Тур	Recitation Section (small)
Hrs/wk	1
СР	1
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Wilfried Schneider
Language	DE
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Course L0541: Simulation in Groundwater Hydrology		
Тур	Lecture	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Sonja Götz (geb. Schröter)	
Language	DE	
Cycle	WiSe	
	Basics and theoretical background of simulation models frequently used in science and practise for pumping test analysis, water movement in vadose zone, solute transport in vadose zone, groundwater recharge, solute transport in groundwater	
Literature	Handbücher der verwendeten Slumationsmodelle werden bereitgestellt.	

Course L0542: Simulation in Groundwater Hydrology		
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Sonja Götz (geb. Schröter)	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M1350	D: Excavation Law and P	rojects		
Courses				
_	and Engineering Law (L0395) Procurement Law (L1906) 0708)	<b>Typ</b> Lecture Lecture Project-/problem- based Learning	Hrs/wk 2 2 2	<b>CP</b> 2 2 2
Module Responsible Admission	Prof. jurgen Grabe	·		
Requirements  Recommended  Previous  Knowledge	None			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence Knowledge Skills				
Personal Competence Social Competence Autonomy				
	I Independent Study Time 96, Study	Time in Lecture 84		
Credit points				
Course achievement	None			
Examination	Oral exam			
Examination duration and scale				
Assignment for the Following Curricula	Civil Engineering: Specialisation Co Civil Engineering: Specialisation Ge Civil Engineering: Specialisation Str Civil Engineering: Specialisation Wa	otechnical Engineering: E ructural Engineering: Elec	lective Com tive Compul	pulsory

Typ Lecture  Hrs/wk 2  CP 2  Workload in Hours Independent Study Time 32, Study Time in Lecture 28  Lecturer Prof. Günther Schalk  Language DE  Cycle WiSe  • History of Civil Engineering Law (from 1700 BC to 2000 AD)  • Basics of foundation and excarvation law / engineering law (the participants in to see the content of
CP 2  Workload in Hours Independent Study Time 32, Study Time in Lecture 28  Lecturer Prof. Günther Schalk  Language DE  Cycle WiSe  History of Civil Engineering Law (from 1700 BC to 2000 AD)
Workload in Hours Independent Study Time 32, Study Time in Lecture 28  Lecturer Prof. Günther Schalk  Language DE  Cycle WiSe  History of Civil Engineering Law (from 1700 BC to 2000 AD)
Lecturer Prof. Günther Schalk  Language DE  Cycle WiSe  History of Civil Engineering Law (from 1700 BC to 2000 AD)
Language DE Cycle WiSe  • History of Civil Engineering Law (from 1700 BC to 2000 AD)
Cycle WiSe  • History of Civil Engineering Law (from 1700 BC to 2000 AD)
History of Civil Engineering Law (from 1700 BC to 2000 AD)
Basics of foundation and excarvation law / engineering law (the participants in t
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 engineeric contract design and execution)
• The liability of the planner and entrepreneur in civil engineering (practice examples, jurisprudence and law, inter alia, to the Ordinance on Combatan liability for defects and traffic safety obligations, construction law and insuran 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 ca constellations)
The (construction) conflict, the dispute avoidance models and the construction process (practice-oriented presentation)
Folienskript (in der Vorlesung erhältlich)
weitere Literatur:  Literature
Englert, Grauvogel und Maurer: Handbuch des Baugrund- und Tiefbaurech     Werner-Verlag

Course L1906: Service Contract and Procurement Law	
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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 Geotechnics		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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	

Admission Requirements Recommended Previous Knowledge	Prof. Kerstin Kuchta  None  chemical and biological  After taking part succes  The module aims posse treatment plants. Stude and aerobic waste tree	sfully, stu ess knowl ents are a	Pro bas dents have	ctical Course ject-/problem- sed Learning	Hrs/wk 2 3	CP 2 4
Waste and Environment Biological Waste Treatment Module Responsible Admission Requirements Recommended Previous Knowledge Educational Objectives Professional	Prof. Kerstin Kuchta  None  chemical and biological  After taking part succes  The module aims posse treatment plants. Stude and aerobic waste tree	sfully, stu ess knowl ents are a	Pra Pro bas dents have	ctical Course ject-/problem- sed Learning	2 3	2 4
Module Responsible Admission Requirements Recommended Previous Knowledge Educational Objectives Professional	Prof. Kerstin Kuchta  None  chemical and biological  After taking part succes  The module aims posse treatment plants. Stude and aerobic waste tree	sfully, stu ess knowl ents are a	dents have	sed Learning		
Admission Requirements Recommended Previous Knowledge Educational Objectives Professional	Chemical and biological  After taking part succes  The module aims posse treatment plants. Stude and aerobic waste tree	sfully, stu ess knowl ents are a	edge conce	reached the fol	lowing learn	ing results
Recommended Previous Knowledge Educational Objectives Professional	chemical and biological  After taking part succes  The module aims posse treatment plants. Stude and aerobic waste tree	sfully, stu ess knowl ents are a	edge conce	reached the fol	lowing learn	ing results
Recommended Previous Knowledge Educational Objectives Professional	After taking part succes  The module aims posse treatment plants. Stude and aerobic waste tree	sfully, stu ess knowl ents are a	edge conce	reached the fol	lowing learn	ing results
Professional	The module aims posse treatment plants. Stude and aerobic waste tre-	ess knowl ents are a	edge conce	reached the fol	lowing learn	ing results
Professional	treatment plants. Stude and aerobic waste treatment	ents are a				
Competence	treatment plants. Stude and aerobic waste treatment	ents are a				
Į.	treatment plants. Stude and aerobic waste treatment	ents are a		erning the plant	ning of high	naical wasto
Knowledge	The module aims possess knowledge concerning the planning of biological waste treatment plants. Students are able to explain the design and layout of anaerobic and aerobic waste treatment plants in detail, describe different techniques for waste gas treatment plants for biological waste treatment plants and explain different methods for waste analytics.					
Skills	The students are able to discuss the compilation of design and layout of plants. They can critically evaluate techniques and quality control measurements. The students can recherché and evaluate literature and date connected to the tasks given in der module and plan additional tests. They are capable of reflecting and evaluating findings in the group.					
Personal Competence	Students can narticin	ato in si	uhioct spac	ific and intord	lisciplinary	discussions
	Students can participate in subject-specific and interdisciplinary discussions, develop cooperated solutions and defend their own work results in front of others and promote the scientific development in front of colleagues. Furthermore, they can give and accept professional constructive criticism.					
Autonomy	Students can independently tap knowledge from literature, business or test reports and transform it to the course projects. They 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 accordance with the potential social, economic and cultural impact.					
Workload in Hours	Independent Study Time	= 110, Stu	dy Time in	Lecture 70		
Credit points			-			
Course achievement	Compulsor <b>B</b> onus Yes None	Form Subject practical	theoretica work	<b>Descrip</b> Il and	otion	
Examination	Presentation					
Examination						

duration and scale	Elaboration and Presentation (15-25 minutes in groups)
Assignment for the Following Curricula	

Course L0328: Waste and Environmental Chemistry		
Тур	Practical Course	
Hrs/wk	2	
СР	2	
<b>Workload in Hours</b>	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: Biol	ogical Waste Treatment		
Тур	Project-/problem-based Learning		
Hrs/wk	3		
СР	4		
<b>Workload in Hours</b>	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 M0949: Rural Development and Resources Oriented Sanitation for different Climate Zones

Courses				
Title	d Pasaureas Oriented Sanitation for different	Тур	Hrs/wk	СР
Rural Development and Resources Oriented Sanitation for different Climate Zones (L0942)  Seminar 2		2	3	
Climate Zones (L0941)	d Resources Oriented Sanitation for different	Lecture	2	3
Module Responsible	I Prof. Raif Ciffernoni			
Admission Requirements	None			
	Basic knowledge of the global situation with rising poverty, soil degradation, lack of water resources and sanitation			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
	Students can describe resources orient source control in detail. They can community water, nutrients and soil conditioners.			
Knowledge	Students are able to discuss a wide range of proven approaches Development from and for many regions of the world.			es in Rural
Skills	Students are able to design low-tech/low-cost sanitation, rural water supply, rainwater harvesting systems, measures for the rehabilitation of top soil quality combined with food and water security. Students can consult on the basics of soil building through "Holisitc Planned Grazing" as developed by Allan Savory.			
Personal Competence				
Social Competence	The students are able to develop a specific topic in a team and to work out milestones according to a given plan.			
Autonomy	Students are in a position to work on a subject and to organize their work flow independently. They can also present on this subject.			
Workload in Hours	Independent Study Time 124, Study Time	e in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
duration and	During the course of the semester, the students work towards mile stones. The work includes presentations and papers. Detailed information will be provided at the beginning of the smester.			
	Civil Engineering: Specialisation Water ar Bioprocess Engineering: Specialisation A Compulsory Chemical and Bioprocess Engineering: S Elective Compulsory Energy and Environmental Engineering: Engineering: Elective Compulsory Environmental Engineering: Specialisatio	- General Bioproces  Specialisation Genera  Specialisation Ener	s Engineer Il Process gy and Er	Engineering
Assignment for	International Management and Engi			Energy and

the Following	Environmental Engineering: Elective Compulsory
Curricula	Joint European Master in Environmental Studies - Cities and Sustainability:
	Specialisation Water: Elective Compulsory
	Process Engineering: Specialisation Environmental Process Engineering: Elective
	Compulsory
	Process Engineering: Specialisation Process Engineering: Elective Compulsory
	Water and Environmental Engineering: Specialisation Water: Elective Compulsory
	Water and Environmental Engineering: Specialisation Environment: Elective
	Compulsory
	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory

Course L0942: Rui Zones	ral Development and Resources Oriented Sanitation for different Climate		
Тур	Seminar		
Hrs/wk	2		
СР	3		
<b>Workload in Hours</b>	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 Development and Resources Oriented Sanitation for different Climate Zones				
Тур	Lecture			
Hrs/wk	2			
СР	3			
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28			
Lecturer	r Prof. 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>			

C					
Courses					
Title		<b>Typ</b> Project-/problem-	Hrs/wk	CP	
Process Modelling of Wastewater Treatment (L0522)		based Learning Project-/problem-	2	3	
Process Modeling in Di	rinking Water Treatment (L0314)	based Learning	2	3	
Module Responsible	Dr. Klaus Johannsen				
Admission Requirements	None				
Recommended Previous Knowledge	Knowledge of the most important processes in drinking water and waste water treatment.				
Educational Objectives	After taking part successfully, students have reached the following learning results				
Professional Competence					
Knowledge	Students are able to explain selected processes of drinking water and waste water				
Skills	Students are able to use the most important features Modelica offers. They are able to transpose selected processes in drinking water and waste water treatment into a mathematical model in Modelica with respect to equilibrium, kinetics and mass balances. They are able to set up and apply models and assess their possibilitie and limitations.				
Personal Competence	Students are able to solve prob			•	
Social Competence	members of different technical background. They are able to give approfeedback and can work constructively with feedback concerning their work.				
Autonomy	Students are able to define a problem, gain the required knowledge and set up model.				
Workload in Hours	Independent Study Time 124, Stud	ly Time in Lecture 56			
Credit points	6				
Course achievement					
Examination	Written exam				
Examination duration and scale	1,5 hours				
	Civil Engineering: Specialisation W Environmental Engineering: Specia				

Process Engineering: Specialisation Process Engineering: Elective Compulsory						
Water ar	nd Er	vironmental Eng	jineering: Spec	ialisation Water	: Elective Comp	ulsory
Water a	and	Environmental	Engineering:	Specialisation	Environment:	Elective
Compuls	ory					
Water ar	nd En	vironmental Eng	gineering: Spec	ialisation Cities:	Elective Comp	ulsory

Course L0522: Prod	cess Modelling of Wastewater Treatment
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	3
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Joachim Behrendt
Language	DE/EN
Cycle	WiSe
	Mass and energy balances
	Tracer modelling
	Activated Sludge Model
Content	Wastewater Treatment Plant Modelling (continously and SBR)
	Sludge Treatment (ADM, aerobic autothermal)
	Biofilm Modelling
Henze, Mogens (Seminar on Activated Sludge Modelling, ; Kollekolle Seminar of Activated Sludge Modelling, ;) Activated sludge modelling : processes in theory and practice ; select proceedings of the 5th Kollekolle Seminar on Activated Sludge Modelling, held 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/dokser id=2774611&prov=M&dok_var=1&dok_ext=htm Weinheim: WILEY-VCH, 2007 TUB_HH_Katalog	

Course L0314: Process Modeling in Drinking Water Treatment				
Тур	Project-/problem-based Learning			
Hrs/wk	2			
СР	3			
<b>Workload in Hours</b>	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	OpenModelica: https://openmodelica.org/index.php/download/download-windows  OpenModelica - Modelica Tutorial: https://openmodelica.org/index.php/useresresources/userdocumentation  OpenModelica - Users Guide: https://openmodelica.org/index.php/useresresources/userdocumentation  Peter Fritzson: Principles of Object-Oriented Modeling and Simulation with Modelica 2.1, Wiley-IEEE Press, ISBN 0-471-471631.  MHW (rev. by Crittenden, J. et al.): Water treatment principles and design. John Wiley & Sons, Hoboken, 2005.  Stumm, W., Morgan, J.J.: Aquatic chemistry. John Wiley & Sons, New York, 1996.  DVGW (Hrsg.): Wasseraufbereitung - Grundlagen und Verfahren. Oldenbourg Industrie Verlag, München, 2004.			

Module M0620	D: Special Aspect	ts of Waste	Resource Ma	nageme	nt		
Courses							
Title			Тур	Hrs/wk	СР		
Advanced Topics in Wa	aste Resource Managemen	t (L1055)	Project-/problem- based Learning	3	3		
International Waste Ma	anagement (L0317)  Project-/problem- 2 3 based Learning						
1100 p 011011010							
Admission Requirements	None						
Recommended Previous Knowledge	basics in waste treatme	nt technologies					
Educational Objectives	After taking part succes	sfully, students h	ave reached the foll	lowing learn	ing results		
Professional Competence							
Knowledge	technologies for recycl	The students are able to describe waste as a resource as well as advanced technologies for recycling and recovery of resources from waste in detail. This covers collection, transport, treatment and disposal in national and international contexts.					
Skills	national or cultural and	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, participate in subject-specific and interdisciplinary discussions, develop cooperated solutions and defend their own work results in front of others and promote the scientific development of colleagues. Furthermore, they can give and accept professional constructive criticisms.						
Autonomy	Students can independe it in solving the given co			e subject ar	ea and apply		
<b>Workload in Hours</b>	Independent Study Time	e 110, Study Time	e in Lecture 70				
Credit points	6						
Course achievement	Compulsor <b>₽</b> onus Yes 20 %	<b>Form</b> Written elaborati	<b>Descri</b> p on	otion			
Examination	Presentation						
Examination duration and scale	PowerPoint presentation	n (10-15 minutes)					
Assignment for the Following Curricula		ring: Specialisatio r in Environmer Elective Compulso al Engineering: Sp ental Engineerin	n Waste and Energy ntal Studies - Citi ry pecialisation Water: g: Specialisation	<ul><li>Elective Color</li><li>Elective Color</li><li>Environmen</li></ul>	ustainability: mpulsory nt: Elective		

Course L1055: Advanced Topics in Waste Resource Management				
Тур	Project-/problem-based Learning			
Hrs/wk	3			
СР	3			
<b>Workload in Hours</b>	Independent Study Time 48, Study Time in Lecture 42			
Lecturer	Prof. Rüdiger Siechau			
Language	EN			
Cycle	WiSe			
	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).			
	The course is split into two parts:  1. part: "Conventional" lecture (development of waste management, legislation, collection, transportation and organisation of waste management, costs, fees and revenues).			
Content	2. 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.			
	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.			
Literature	Einführung in die Abfallwirtschaft; Martin Kranert, Klaus Cord-Landwehr (Hrsg.); Vieweg + Teubner Verlag; 2010 PowerPoint slides in Stud IP			

Course L0317: Inte	rnational Waste Management
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	3
<b>Workload in Hours</b>	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

Module M0713	3: C	oncrete St	ruc	tures					
Courses									
Title					Тур		Hrs/wl	, (	CP
Concrete Structures (L	0579)	1			Seminar		1 1 5/W		L
Structural Concrete Me	ember	rs (L0577)			Lecture		2	3	3
Structural Concrete Me	ember	rs (L0578)			Recitation (large)	Section	12	2	2
Module Responsible	Prof.	Günter Rombad	ch						
Admission Requirements	None	9							
-	Basic	cs of structural a	analy	sis, conception	and dimens	ioning of s	tructura	ıl co	ncrete
Recommended	Mod	ules: Reinforced	l Con	crete Structures	I+II, Struct	ural Analy:	sis I+II,	Mec	hanics I+I
Previous					·	,	·		
Knowledge									
Educational Objectives	After	taking part suc	ccess	fully, students h	ave reache	d the follo	wing lea	rnin	g results
Professional									
Competence	The	students broads	an th	eir skills in stru	ctural engin	eerina es	necially	in t	he field of
Knowledge	build	lings (houses, r	oofs,	halls). They dis uildings and stru	spose of the	e knowled	ge for t	he c	onception
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.						concrete detailing		
Personal Competence									
Social Competence	The :	students are ab	le to	obtain results o	f high qualit	y in teamv	work.		
Autonomy		students are ab ctures under the		carry out com	plex concep	otion and	dimensi	onin	g tasks of
Workload in Hours		pendent Study	Time	110, Study Time	e in Lecture	70			
Credit points		nulcorPonuc				Docarinti	ion		
Course achievement		npulsor <b>Bonus</b> None		Form Presentation		<b>Descript</b> i Es wer ausgegeb	den	2	Referate
Examination	Writt	en exam				adsgegeb			
Examination duration and scale									
Assignment for the Following Curricula	Civil Civil Civil Inter	Engineering: Sp Engineering: Sp Engineering: Sp	pecia pecia pecia geme	lisation Structur lisation Geotech lisation Coastal lisation Water a ent and Engine	inical Engine Engineering nd Traffic: E	eering: Ele : Elective :lective Co	ctive Co Compul mpulsor	sory y	-

Course L0579: Concrete Structures				
Тур	Seminar			
Hrs/wk	1			
СР	1			
<b>Workload in Hours</b>	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 L0577: Stru	ictural Concrete Members
Тур	Lecture
Hrs/wk	2
СР	3
<b>Workload in Hours</b>	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>
Literature	<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,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 Concrete Members			
Тур	Recitation Section (large)		
Hrs/wk	2		
СР	2		
<b>Workload in Hours</b>	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 M0722	2: Comp	utationa	al Analysis o	f Concrete S	Structures			
Courses								
Title	Typ Hrs/wk Cos of Concrete Structures (L0598) Lecture 2 3							
Computational Analysi	s of Concrete	Structures (	L0599)	Recitation Section 1 1 (large)				
FE-Modeling of Concre	te Structures	Project /problem						
Module Responsible	Prof. Günte	r Rombach						
Admission Requirements	None							
	Basic know (beams, sla		ructural analysis a ralls).	nd design of rein	forced concret	e structures		
Recommended Previous	Lectures 'C	Concrete Str	uctures I und II'					
Knowledge	Lectures 'S	tructural Ar	nalysis I and II'					
	Lecture 'Co	ncrete Stru	ctures'					
Educational Objectives	After taking	part succe	ssfully, students h	ave reached the	following learn	ing results		
Professional Competence								
Knowledge	The studen concrete st	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 student of a finite e	ts can mode lement soft	el and design in te ware package.	amwork a real co	ncrete structu	e by means		
Autonomy			del and design a ckage and discu:					
<b>Workload in Hours</b>	l —————	nt Study Tim	ne 110, Study Tim	e in Lecture 70				
Credit points	!							
Course achievement		<b>r₿onus</b> None	<b>Form</b> Attestation	Am I Trags Rech	c <b>ription</b> Ende des Sem system mi enprogramm ellieren			
	Yes	None	Excercises		st ein Trags OY zu modellier			
Examination	Oral exam							
Examination duration and scale								
Assignment for the Following Curricula	Civil Engine Civil Engine	ering: Specering: Spec	ialisation Structur ialisation Geotech ialisation Coastal ialisation Water a	nical Engineering Engineering: Elec	g: Elective Com tive Compulso	pulsory		

Course L0598: Com	putational Analysis of Concrete Structures
Тур	Lecture
Hrs/wk	2
СР	3
<b>Workload in Hours</b>	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: Computational Analysis of Concrete Structures			
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	1		
<b>Workload in Hours</b>	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-I	Modeling of Concrete Structures
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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>

Module M0963	3: Steel and Compo	osite Stru	ctures								
Courses											
<b>Title</b> Steel and Composite S	tructures (L1204)		<b>Typ</b> Lecture		Hrs/wk	<b>CP</b> 2					
Steel and Composite S			Recitation	Section	· <del>-</del>	2					
Steel Bridges (L1097)	indicates (E1203)		(large) Lecture		2	2					
						_					
Кезропзівіс	Prof. Marcus Rutner										
Admission Requirements	None										
Recommended Previous Knowledge	Basics of steel construction	n (i.e. Steel Str	uctures I and	l II, BUBC	C)						
Educational Objectives	After taking part successfu	lly, students h	ave reached	the follo	wing learr	ing results					
Professional Competence		on students s	<b>.</b> n								
Knowledge	<ul> <li>describe the phenon</li> <li>explain warping tors</li> <li>illustrate the behavi</li> <li>specify the principle</li> </ul>	<ul> <li>After successful completition, students can</li> <li>describe the phenomenon of local buckling</li> <li>explain warping torsion</li> <li>illustrate the behaviour of composite structures</li> <li>specify the principles in design of composite structures</li> <li>sketch the contructions of steel and composite bridges</li> </ul>									
Skills	<ul><li>check stiffened and</li><li>recognize and verify</li><li>design composite st</li></ul>	After successful participation students are able to  check stiffened and unstiffened plated structures recognize and verify warping tosion in strucures design composite structures design bridges and o perform the detailing									
Personal											
Competence											
Social Competence											
Autonomy		6 C+u,du T!	in Lostura Cr	1							
Credit points	Independent Study Time 9	o, Study TIME	iii Lecture 84	+							
Course											
achievement  Examination	Written evam										
Examination duration and scale											
Assignment for the Following Curricula	Civil Engineering: Specialis Civil Engineering: Specialis Civil Engineering: Specialis	ation Geotech ation Coastal I ation Water ar	nical Enginee Engineering: nd Traffic: Ele	ering: Ele Elective ective Co	Civil Engineering: Specialisation Structural Engineering: Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering:						

Course L1204: Steel and Composite Structures	
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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 Composite Structures	
Тур	Recitation Section (large)
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	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: Stee	el Bridges
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Jörg Ahlgrimm
Language	
Cycle	Wise  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
Content	-> 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. 114</li> </ul>

Credit points 6

Curricula

**Assignment for** 

the Following

## Module M0969: Selected Topics in Civil Engineering **Courses Title** CP Typ Hrs/wk Analysis of Offshore Structures (L1867) Lecture 1 1 Excellence in International Project Delivery (L2387) 2 2 Integrated Lecture Design of Prefabricated Concrete Structures (L0596) Lecture 1 1 Section 1 Recitation Design of Prefabricated Concrete Structures (L0597) 1 (large) Forum I - Geotechnics and Construction Management (L1634) 1 Seminar 1 Forum II - Geotechnics and Construction Management (L1635) Seminar 1 1 2 Geotechnical Engineering Design (L2447) Lecture 3 2 Timber Structures (L1151) Seminar 2 Glass Structures (L1152) Lecture 2 2 Section <sub>1</sub> Recitation Glass Structures (L1447) 1 (large) 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 Wind turbine design (L1905) Lecture 1 Module Prof. Uwe Starossek Responsible **Admission** None Requirements Recommended **Previous** none **Knowledge Educational** After taking part successfully, students have reached the following learning results **Objectives 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 Knowledge 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 Skills structural engineering. **Personal** Competence Social Competence Students can chose independently, in which fields they want to deepen their Autonomy knowledge and skills through the election of courses. Workload in Hours Depends on choice of courses

Civil Engineering: Specialisation Structural Engineering: Elective Compulsory

Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory

Civil Engineering: Specialisation Water and Traffic: Elective Compulsory

Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory

Course L1867: Ana	lysis of Offshore Structures
Тур	Lecture
Hrs/wk	1
СР	1
	Independent Study Time 16, Study Time in Lecture 14
Examination Form	
Examination duration and 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
Content	Topic 5: Linear-Time-Invariant Systems, response of an LTI-system in frequency domain
Content	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
	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
Literature	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
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Examination Form</b>	laut FSPO
Examination duration and scale	wird zu Beginn der Lehrveranstaltung festgelegt
Lecturer	NN
Language	EN
Cycle	SoSe
Content	
Literature	

Course L0596: Desi	Course L0596: Design of Prefabricated Concrete Structures	
Тур	Lecture	
Hrs/wk	1	
СР	1	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
<b>Examination Form</b>	Klausur	
Examination duration and 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> <li>Broschüren der Fachvereinigung Deutscher Betonfertigteilbau e.V. siehe: www.fdb-fertigteilbau.de 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
<b>Examination Form</b>	Klausur
Examination duration and scale	Siehe korrespondierende Vorlesung
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
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Examination Form</b>	Mündliche Prüfung
Examination duration and scale	30 min
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
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14
<b>Examination Form</b>	Mündliche Prüfung
Examination duration and scale	30 min
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
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28
<b>Examination Form</b>	Schriftliche Ausarbeitung
Examination duration and scale	45 Min.
Lecturer	Prof. Jürgen Grabe, 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
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Examination Form</b>	Referat
Examination duration and scale	90 min
Lecturer	Prof. Torsten Faber
Language	DE
Cycle	WiSe
Content	
Literature	

Course L1152: Glass Structures	
Тур	Lecture
Hrs/wk	2
СР	2
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28
<b>Examination Form</b>	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	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
<b>Examination Form</b>	Mündliche Prüfung	
Examination duration and scale		
Lecturer	Marvin Matzik	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

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	
<b>Examination Form</b>	laut FSPO	
Examination duration and scale	wird zu Beginn der Lehrveranstaltung festgelegt	
Lecturer	Dozenten des SD B	
Language	DE	
	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	
<b>Workload in Hours</b>	Independent Study Time 32, Study Time in Lecture 28	
<b>Examination Form</b>	laut FSPO	
Examination duration and scale	wird zu Beginn der Lehrveranstaltung festgelegt	
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	
<b>Workload in Hours</b>	Independent Study Time 48, Study Time in Lecture 42	
<b>Examination Form</b>	laut FSPO	
Examination duration and scale	wird zu Beginn der Lehrveranstaltung festgelegt	
Lecturer	Dozenten des SD B	
Language	DE	
	WiSe/SoSe	
Content	The course occurs only if required. The content is defined at short notice.	
Literature	Die Literatur wird kurzfristig festgelegt.	

Course L1905: Wind turbine design		
Тур	Lecture	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
<b>Examination Form</b>	Mündliche Prüfung	
Examination duration and scale		
Lecturer	Dr. Jörn Scheller	
Language	DE	
Cycle	WiSe	
Content		
Literature		

Module M0699	9: Geotechnics III			
Courses				
<b>Title</b> Numerical Methods in Geotechnics (L0375) Advanced Foundation Engineering (L0497) Advanced Foundation Engineering (L0498)		<b>Typ</b> Lecture Lecture Recitation (large)	Hrs/wk 3 2 Section 1	<b>CP</b> 3 2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous Knowledge				
Educational Objectives	After taking part successfully, s	students have reached th	ne following learn	ing results
Professional Competence <i>Knowledge</i>				
Skills				
Personal Competence Social Competence Autonomy				
<b>Workload in Hours</b>	Independent Study Time 96, St	udy Time in Lecture 84		
Credit points	6			
Course achievement	CompulsorBonus Form Yes None Subject practic		escription	
Examination	Written exam			
Examination duration and scale				
Assignment for the Following Curricula	Civil Engineering: Specialisation Civil Engineering: Specialisation Civil Engineering: Specialisation Civil Engineering: Specialisation International Management an Elective Compulsory	n Geotechnical Engineer n Coastal Engineering: C n Water and Traffic: Elec	ing: Compulsory ompulsory tive Compulsory	Engineering:

Course L0375: Numerical Methods in Geotechnics			
Тур	Lecture		
Hrs/wk	3		
СР	3		
<b>Workload in Hours</b>	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Dr. Hans Mathäus Stanford		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Topics:</li> <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 Foundation Engineering			
Тур	Lecture		
Hrs/wk	2		
СР	2		
<b>Workload in Hours</b>	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	
<b>Workload in Hours</b>	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Jürgen Grabe	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M140	L: Study work Water and Traffic
Courses	
Title	Typ Hrs/wk CP
Admission Requirements	None
Recommended Previous Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	The students are able to demonstrate their detailed knowledge in the field of water management and waste. They can exemplify the state of technology and application and discuss critically in the context of actual problems and general conditions of science and society.  The students can develop solving strategies and approaches for fundamental and practical problems in the field of water management and waste. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic 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 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 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 for the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to their colleagues.
Autonomy	The students are capable of independently planning and documenting the work steps and procedures while considering the given deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedback from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology.
	Independent Study Time 180, Study Time in Lecture 0
Credit points	
Course achievement	
Examination	
Examination duration and scale	See FSPO
Assignment for the Following Curricula	Civil Engineering: Specialisation Water and Traffic: Compulsory

Module M0864	4: Practical Course in Water	r and Wastewa	ater Tec	hnology
Courses				
	ter and Wastewater Technology I (L0503) stewater Technology II (L0607)	<b>Typ</b> Practical Course Practical Course	<b>Hrs/wk</b> 2 3	<b>CP</b> 3 3
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in chemistry and physi	cs (knowledge acqui	red at schoo	ol)
Educational Objectives	I ATTOR TAKING NART CHCCOCCTIIIIV CTHOONTC	After taking part successfully, students have reached the following learning results		
Professional Competence				
Knowledge	The students know basic analytical procedures for evaluating the quality of water and wastewater. They have knowledge about fundamental process engineering features of important water and wastewater treatment technologies.			
Skills	The students are able to understand and to practically apply methodologies for wastewater analysis as well as descriptions of experiments and experimental setups in wastewater 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 Tim	ne in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and scale				
the Following	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Water and Environmental Engineering: Specialisation Water: Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Elective Compulsory Water and Environmental Engineering: Specialisation Cities: Elective Compulsory			

Course L0503: Practical Course in Water and Wastewater Technology I		
Тур	Practical Course	
Hrs/wk	2	
СР	3	
<b>Workload in Hours</b>	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Dr. Dorothea Rechtenbach	
Language	EN	
Cycle	WiSe	
	- Impact of pretreatment of wastewater samples on analytical results	
	- Analysis of nutrients in wastewater samples (different methods for nitrate analysis)	
Content	- 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	

Module M0583	L: Water Protection			
Courses				
	Nastewater Management (L0226) Nastewater Management (L2008)	<b>Typ</b> Lecture Project Seminar	<b>Hrs/wk</b> 3 3	<b>CP</b> 3 3
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
Recommended Previous Knowledge	Good knowledge in urban dra     Good knowledge of wastowa	ainage; ter treatment technique		properties;
Educational Objectives	After taking part successfully, stude	ents have reached the fo	ollowing learn	ing results
Professional Competence				
Knowledge	The students can describe the bas to the international and Europea processes, substance cycles and assess complex problems related and wastewater treatment with a s measures as well as conceptual appropriate the student with th	n water sector. They water morphology in o to water protection, su pecial focus on innovati	can explain detail. They ch as ecosys	limnological are able to tem service
Skills	Students can accurately assess of specific or local context. They can planning of tomorrow's urban of appropriate technical, administral problems.	n suggest concrete acti water cycle. Furtherm	ons to contri ore, they c	bute to the an suggest
Personal Competence	The students can work together in i	nternational groups.		
Social Competence				
	Students are able to organize t discussions. They can acquire independently.			
Autonomy				
Workload in Hours	Independent Study Time 96, Study	Time in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Presentation			

Examination duration and scale	Term paper plus presentation
Assignment for the Following Curricula	International Management and Engineering: Specialisation II. Civil Engineering:

Course L0226: Water Protection and Wastewater Management		
Тур	Lecture	
Hrs/wk	3	
СР	3	
<b>Workload in Hours</b>	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Ralf Otterpohl	
Language	EN	
Cycle	WiSe	
Content	<ul> <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	
<b>Workload in Hours</b>	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
Membrane Technology	(L0399)	Lecture	2	3
Membrane Technology	(L0400)	Recitation Sect (small)	ion 1	2
Membrane Technology	(L0401)	Practical Course	1	1
ntespenionale				
Admission Requirements	None			
	Basic knowledge of water chemistry. Kn water, gas and steam treatment	nowledge of the cor	e processes	involved in
Educational Objectives	After taking part successfully, students	have reached the fo	llowing learr	ning results
Professional Competence				
Knowledge	Students will be able to rank the technical applications of industrially important membrane processes. They will be able to explain the different driving forces behind existing membrane separation processes. Students will be able to name materials used in membrane filtration and their advantages and disadvantages. Students will be able to explain the key differences in the use of membranes in water, other liquid media, gases and in liquid/gas mixtures.			
Skills	Students will be able to prepare mathematical equations for material transport in porous and solution-diffusion membranes and calculate key parameters in the membrane separation process. They will be able to handle technical membrane processes using available boundary data and provide recommendations for the sequence of different treatment processes. Through their own experiments, students will be able to classify the separation efficiency, filtration characteristics and application of different membrane materials. Students will be able to characterise the formation of the fouling layer in different waters and apply technical measures to control this.			
Personal Competence				
Social Competence	Students will be able to work in divers technology. They will be able to make experiments to be undertaken jointly an	decisions within th	eir group oi	
Autonomy	Students will be in a position to sol technology independently. They will b technical questions.			
Workload in Hours	Independent Study Time 124, Study Tim	ne in Lecture 56		
Credit points	6			
Course achievement	INONE			
	  Written exam			
Examination duration and scale	90 min			
33310	Civil Engineering: Specialisation Water a Bioprocess Engineering: Specialisation A Compulsory Bioprocess Engineering: Specialisation	A - General Bioproce	ess Engineer	_

	Elective Compulsory
	Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering:
	Elective Compulsory
	Chemical and Bioprocess Engineering: Specialisation General Process Engineering:
	1
	Elective Compulsory
Assignment for	Energy and Environmental Engineering: Specialisation Energy and Environmental
the Following	Engineering: Elective Compulsory
Curricula	Environmental Engineering: Specialisation Water: Elective Compulsory
	Joint European Master in Environmental Studies - Cities and Sustainability:
	Specialisation Water: Elective Compulsory
	· · · · · · · · · · · · · · · · · · ·
	Process Engineering: Specialisation Process Engineering: Elective Compulsory
	Process Engineering: Specialisation Environmental Process Engineering: Elective
	Compulsory
	Water and Environmental Engineering: Specialisation Water: Elective Compulsory
	Water and Environmental Engineering: Specialisation Environment: Elective
	3 3 1
	Compulsory
	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory

Course L0399: Membrane Technology		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Mathias Ernst	
Language	EN	
Cycle	WiSe	
Content	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 Technology	
Тур	Recitation Section (small)
Hrs/wk	1
СР	2
<b>Workload in Hours</b>	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 Technology	
Тур	Practical Course
Hrs/wk	1
СР	1
<b>Workload in Hours</b>	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

Module M15 Engineering ( <i>I</i>	05: Adaptation to Climate Change in Hydraulic AKWAS)
Courses	
Title	Typ Hrs/wk CP
Adaptation to climate	change in hydraulic engineering (L2291)  Project-/problem- based Learning  4 6
Module Responsible	I Drot Patar Franca
Admission Requirements	None
Recommended Previous Knowledge	Hydromechanic, Hydraulics     Fundamentals of Coastal Engineering, Coastal, and Flood Protection
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	
Knowledge	<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>
Skills	<ul> <li>Critical thinking: analysis of processes and relations, assessment of needs for action</li> <li>Creative thinking: development of adaptation strategies and adaptation measures</li> <li>Practical thinking: inclusion of restrictions, application of calculation approaches, methods, numerical models, planning methods</li> <li>Consideration of complex tasks</li> </ul>
Personal Competence	
Social Competence	<ul> <li>Working in heterogenous groups</li> <li>Working with different scientific / non-scientific disciplines</li> <li>Self reflection</li> </ul>
Autonomy	<ul> <li>Application oriented use of knowledge and skills</li> <li>Autonomous work on complex tasks</li> </ul>
	Independent Study Time 124, Study Time in Lecture 56
Credit points	
Course achievement	None
Examination	Written elaboration

Examination duration and scale	Preparation of a written report and a presentation of a complex task.
Assignment for the Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Water and Environmental Engineering: Specialisation Cities: Elective Compulsory Water and Environmental Engineering: Specialisation Environment: Elective Compulsory 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	
<b>Workload in Hours</b>	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

Courses	
Title	Typ Hrs/wk CP
Module Responsible	
Admission Requirements	<ul> <li>According to General Regulations §21 (1):</li> <li>At least 60 credit points have to be achieved in study programme. Th examinations board decides on exceptions.</li> </ul>
Recommended Previous Knowledge	
Educational Objectives	LATTOR TAKING NART CHECOCCILIIV. CILINONIC NAVO ROJENDO INO INLINWING IDARNING ROCHITC
Professional Competence	
Knowledge	<ul> <li>The students can use specialized knowledge (facts, theories, and methods) of their subject competently on specialized issues.</li> <li>The students can explain in depth the relevant approaches and terminologie in one or more areas of their subject, describing current developments an taking up a critical position on them.</li> <li>The students can place a research task in their subject area in its context an describe and critically assess the state of research.</li> </ul>
Skills	<ul> <li>The students are able:</li> <li>To select, apply and, if necessary, develop further methods that are suitable for solving the specialized problem in question.</li> <li>To apply knowledge they have acquired and methods they have learnt in the course of their studies to complex and/or incompletely defined problems in solution-oriented way.</li> <li>To develop new scientific findings in their subject area and subject them to a critical assessment.</li> </ul>
Personal Competence	
Social Competence	<ul> <li>Both in writing and orally outline a scientific issue for an expert audienc accurately, understandably and in a structured way.</li> <li>Deal with issues competently in an expert discussion and answer them in manner that is appropriate to the addressees while upholding their ow assessments and viewpoints convincingly.</li> </ul>
	Students are able:
Autonomy	<ul> <li>To structure a project of their own in work packages and to work them of 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 scale	According to General Regulations
Assignment for the Following Curricula	Materials Science: Thesis: Compulsory