

# **Module Manual**

Master of Science (M.Sc.) Civil Engineering

Cohort: Winter Term 2021 Updated: 31st May 2023

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#### Program description

#### Content

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

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

#### **Career prospects**

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

#### Learning target

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

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

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

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

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

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

#### **Program structure**

The master program consists of modules which 6 credit points according to ECTS (CP) except for the master thesis. It is divided into a "Core Qualification", into the four alternative specializations "Harbor Construction and Coast Protection", "Underground Engineering", "Structures" and "Water and Traffic", as well as the master thesis. The core qualification covers 24 CP, each specialization covers 66 CP and the master thesis covers 30 CP. The program covers 120 CP in 2 years with 4 terms in total.

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

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

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

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

### **Core Qualification**

Module M0523: Busin	ess & Management
Module Responsible	Prof. Matthias Meyer
Admission Requirements	None
<b>Recommended Previous</b>	None
Knowledge	
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	• Students are able to communicate in small interdisciplinary groups and to jointly develop solutions for complex problems
Autonomy	• Students are capable of acquiring necessary knowledge independently by means of research and preparation of material.
Workload in Hours	Depends on choice of courses
Credit points	6

#### Courses

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

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

# Module Manual M.Sc. "Civil Engineering"

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

Courses

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

Courses				
Title	Тур		Hrs/wk	СР
Finite Element Methods (L0291)	Lecture		2	3
Finite Element Methods (L0804)	Recitation Sect	tion (large)	2	3
Module Responsible				
Admission Requirements	None			
	Mechanics I (Statics, Mechanics of Materials) and Mechanics II (Hydrostatics, Kinematics, Dynamics)			
Knowledge	Mathematics I, II, III (in particular differential equations)			
Educational Objectives	After taking part successfully, students have reached the following learning res	sults		
Professional Competence				
Knowledge	The students possess an in-depth knowledge regarding the derivation of the overview of the theoretical and methodical basis of the method.	ne finite element	method and a	are able to give
Skills	The students are capable to handle engineering problems by formulating suit system matrices, and solving the resulting system of equations.	table finite eleme	nts, assembling	g the correspond
Personal Competence Social Competence	Students can work in small groups on specific problems to arrive at joint solution	ons.		
Autonomy	The students are able to independently solve challenging computational p Problems can be identified and the results are critically scrutinized.	roblems and dev	elop own finite	e element routir
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement				
	No 20 % Midterm			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Core Qualification: Compulsory			
Following Curricula	Energy Systems: Core Qualification: Elective Compulsory			
	Aircraft Systems Engineering: Specialisation Aircraft Systems: Elective Compute	sory		
	Aircraft Systems Engineering: Specialisation Air Transportation Systems: Election	ve Compulsory		
	Aircraft Systems Engineering: Core Qualification: Elective Compulsory			
	International Management and Engineering: Specialisation II. Mechatronics: Ele	ective Compulsory	,	
	International Management and Engineering: Specialisation II. Product Developm	ment and Product	on: Elective Co	mpulsory
	Mechatronics: Core Qualification: Compulsory			
	Biomedical Engineering: Specialisation Implants and Endoprostheses: Compuls	ory		
	Biomedical Engineering: Specialisation Management and Business Administrati	-	oulsory	
	Biomedical Engineering: Specialisation Medical Technology and Control Theory		-	
	Biomedical Engineering: Specialisation Artificial Organs and Regenerative Medi			
	Product Development, Materials and Production: Core Qualification: Compulsor		-	
	Technomathematics: Specialisation III. Engineering Science: Elective Compulso			

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

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

Courses				
Title		Тур	Hrs/wk	СР
Safety, Reliability and Risk Assessr	ment (L1145)	Seminar	2	3
Environment and Sustainability (L0		Lecture	2	3
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements	None			
<b>Recommended Previous</b>	none			
Knowledge				
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Knowledge	Students are able to describe single tech	nniques and to give an overview for the fiel	d of safety and risk as	sessment as wel
	environmental and sustainable engineerin	g, in detail:		
	- beside in active and which little of the			
	<ul> <li>basics in safety and reliability of ter</li> <li>safety and reliability analysis methods</li> </ul>			
	<ul> <li>risk assessment</li> </ul>	Jus		
	<ul> <li>Production and usage of bio-char</li> </ul>			
	<ul> <li>energy production and supply</li> </ul>			
	<ul> <li>sustainable product design</li> </ul>			
Skills		system-oriented methods for risk assessm	-	reporting. They
	evaluate the effort and costs for processe	s and select economically feasible treatment	concepts.	
Personal Competence				
Social Competence				
Autonomy	Students can gain knowledge of the sub	ect area from given sources and transform	it to new questions. Fu	rthermore, they
	define targets for new application or rese	arch-oriented duties in for risk management	and sustainability conce	epts accordance
	the potential social, economic and cultura	l impact.		
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points				
Course achievement				
Examination	Written elaboration			
Examination duration and		in groups)		
scale	( )			
Assignment for the	Civil Engineering: Core Qualification: Com	pulsory		
Following Curricula		C - Bioeconomic Process Engineering, Foc	us Management and	Controlling: Elec
5	Compulsory		J	5
	1 3	g: Specialisation II. Civil Engineering: Elective	e Compulsory	
		uction: Specialisation Product Development: I		
	Product Development, Materials and Prod	uction: Specialisation Production: Elective Cor	npulsory	
		uction: Specialisation Production: Elective Con uction: Specialisation Materials: Elective Com		

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

Course L0319: Environment	and Sustainability
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Kerstin Kuchta
Language	EN
Cycle	WiSe
Content	This course presents actual methodologies and examples of environmental relevant, sustainable technologies, concepts and
	strategies in the field of energy supply, product design, water supply, waste water treatment or mobility. The following list show
	examples.
	Production and Usage of Bio-char
	Engergy production with algae
	Environmental product design
	Clean Development mechanism (CDM)
	Democracy and Energy
	New Concepts for a sustainable Energy Supply
	Recycling of Wind Turbines
	Alternative Mobility
	Disposal of Nuclear Wastes
	Waste2Energy
	Offshore Wind energy
Literature	Wird in der Veranstaltung bekannt gegeben.

# **Specialization Coastal Engineering**

Module M0699: Geote	chnics III			
Courses				
Title		Тур	Hrs/wk	СР
Numerical Methods in Geotechnics	(L0375)	Lecture	3	3
Advanced Foundation Engineering		Lecture	2	2
Advanced Foundation Engineering	L0498)	Recitation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lect	ure 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engi	neering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical E	ngineering: Compulsory		
	Civil Engineering: Specialisation Coastal Engine	ering: Compulsory		
	Civil Engineering: Specialisation Water and Traf	fic: Elective Compulsory		
	International Management and Engineering: Sp	ecialisation II. Civil Engineering: Elective Com	oulsory	

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Non destructive testing of material	s and parts (L2215)	Lecture	2	2
Non destructive testing of material		Project-/problem-based Learning	3	3
Non destructive testing of material	s and parts (L2216)	Recitation Section (large)	1	1
Module Responsible	Prof. Bodo Fiedler			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Written document about theory and praxis			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Elective C	Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engineering: Elective C	Compulsory		
	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Geotechnical Engineering: Elec	ctive Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elective	e Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elective	e Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Con	npulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Con	npulsory		
	Materials Science: Specialisation Engineering Materials: Elective	e Compulsory		

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

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

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

Module M0858: Coast				
Courses				
Title		Тур	Hrs/wk	СР
Basics of Coastal Engineering (L08	)7)	Lecture	3	4
Basics of Coastal Engineering (L14	3)	Project-/problem-based Learning	1	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
<b>Recommended Previous</b>	Basics of hydraulic engineering, hydrology and hy	dromechanics		
Knowledge				
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
<b>Professional Competence</b>				
Knowledge	The students are able to define and explain the basic concepts of coastal engineering and port engineering. They are able to appl			
	the concepts to selected practical problems of coastal engineering. Students can define and determine the basics for design an			
	dimensioning of coastal engineering constructions	S.		
Skills	The students are capable to apply basic design approaches to selected and pre-defined design tasks in coastal engineering.			
Personal Competence				
Social Competence	The students are able to deploy their gained kno	owledge in applied problems such as the desig	n of coastal p	protection structu
	Additionaly, they will be able to work in team with	n engineers of other disciplines, for instance des	signing of coa	stal breakwaters.
Autonomy	The students will be able to independently extend	their knowledge and applyit to new problems		
hatohomy				
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ure 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 2 hours. The	e examination includes tasks with respect to	the general ι	understanding of
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural Engine	eering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Eng	gineering: Compulsory		
	Civil Engineering: Specialisation Coastal Engineer	ing: Compulsory		
	International Management and Engineering: Spec	iplication II. Civil Engineering, Elective Compute	0.01	

Course L0807: Basics of Coas	stal Engineering
Тур	Lecture
Hrs/wk	3
CP	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	<ul> <li>Basics of planning and design <ul> <li>Water levels</li> <li>Currents</li> <li>Waves</li> <li>Ice</li> </ul> </li> <li>Planning and Design in Coastal Engineering <ul> <li>Functional and constructional design</li> <li>Determination of design parameters</li> <li>Design-approaches <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 Coas	se L1413: Basics of Coastal Engineering		
Тур	Project-/problem-based Learning		
Hrs/wk	1		
СР			
Workload in Hours	ependent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Peter Fröhle		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M0964: Unde	rground Constructions				
	J				
Courses					
Title		Тур	Hrs/wk	СР	
Applied Tunnel Constructions (L240	7)	Lecture	2	3	
Introduction to tunnel construction	(L0707)	Lecture	1	2	
Introduction to tunnel construction	(L1811)	Recitation Section (large)	1	1	
Module Responsible	Prof. Jürgen Grabe				
Admission Requirements	None				
<b>Recommended Previous</b>	Modules from Bachelor studies Civil and e	environmental engineering:			
Knowledge					
	Geotechnics I-II				
	Steel Structures I-II				
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results			
Professional Competence					
Knowledge	Knowledge of different tunnel construction	on types as well as special methods and techniqu	es of subsoil const	ruction. The stude	
-	get deeper knowledge of steel and ground engineering as well as constructions knowledge concerning quay walls. Futhermore, th				
	students get all the neccessary knowledge to design singular construction elements for sheet pile walls and they know how t				
	choose the right construction elements depending on the influencing conditions.				
Skills	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 element	ts and connections.			
Personal Competence					
Social Competence	Capacity for teamwork concerning project	t management and design of tunnels.			
Autonomy		ork flow in the framework of a design exercise.			
Workload in Hours	Independent Study Time 124, Study Time	÷			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	120 minutes				
scale					
Assignment for the	Civil Engineering: Specialisation Structura	al Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Compulsory				
	Civil Engineering: Specialisation Coastal Engineering: Compulsory				
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory				
	International Management and Engineerir	an Canadaliantian II. Civil Englishering Elective Ca			

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

Course L0707: Introduction t	o tunnel construction	
Тур	Lecture	
Hrs/wk		
CP		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Dr. 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	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Dr. Marius Milatz	
Language	DE	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

Module M0511: Electi	rical Energy from Solar Radia	ation and Wind Power		
Courses				
Title		Turn	Hana (such	CD.
Sustainability Management (L0007		<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 1
Hydro Power Use (L0013)		Lecture	1	1
Wind Turbine Plants (L0011)		Lecture	2	3
Wind Energy Use - Focus Offshore	L0012)	Lecture	1	1
Module Responsible	Dr. Isabel Höfer			
Admission Requirements	None			
<b>Recommended Previous</b>	Module: Technical Thermodynamics I,			
Knowledge				
	Module: Technical Thermodynamics II,			
	Module: Fundamentals of Fluid Mechanics	5		
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge	By ending this module students can exp	plain in detail knowledge of wind turbines wit	h a particular focus of	f wind energy use
		nent these aspects in consideration of current		
	to describe fundamentally the use of wat	er power to generate electricity. The students	reproduce and explain	the basic procedu
	in the implementation of renewable energy	gy projects in countries outside Europe.		
		ppics within the seminar of the module, stud		derstanding and t
	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	d theoretical foundations on exemplary water	r or wind power system	ns and evaluate a
		hips in the context of dimensioning and oper-		
	compare critically the special procedure	for the implementation of renewable energy p	rojects in countries out	side Europe with t
	in principle applied approach in Europe a	nd can apply this procedure on exemplary the	oretical projects.	
Personal Competence				
Social Competence	Students can discuss scientific tasks sub	jet-specificly and multidisciplinary within a ser	ninar.	
Autonomy		rces in the context of the emphasis of the le	cture material to clear	the contents of t
	lecture and to acquire the particular know	vledge about the subject area.		
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	2.5 hours written exam + written elabora	tion (incl. presentation) in sustainability mana	gement	
scale				
Assignment for the	Civil Engineering: Specialisation Structura	al Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotech	nical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal E	Engineering: Elective Compulsory		
	International Management and Engineeri	ng: Specialisation II. Energy and Environmenta	l Engineering: Elective	Compulsory
	International Management and Engineeri	ng: Specialisation II. Renewable Energy: Electiv	ve Compulsory	
	Product Development, Materials and Proc	luction: Specialisation Product Development: E	lective Compulsory	
	Product Development, Materials and Proc	luction: Specialisation Production: Elective Cor	npulsory	
	Product Development, Materials and Proc	luction: Specialisation Materials: Elective Com	oulsory	
	Renewable Energies: Core Qualification: (	Compulsory		
	Theoretical Mechanical Engineering: Spec	cialisation Energy Systems: Elective Compulso	ry	
	Process Engineering: Specialisation Envir	onmental Process Engineering: Elective Comp	ulsory	
	Water and Environmental Engineering: Sp	pecialisation Environment: Compulsory		
	Water and Environmental Engineering: Sp	pecialisation Cities: Elective Compulsory		

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

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Digital Building (L1908)		Lecture	2	2
Lean Construction (L1910)		Lecture	2	2
System Dynamics (L1909)		Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time	e in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotec	hnical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Structu	ral Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water a	and Traffic Elective Compulson		

Course L1908: Digital Building		
Тур	icture	
Hrs/wk		
CP	2	
Workload in Hours	ependent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Daniel Krause	
Language	DE	
Cycle	SoSe	
Content		
Literature		

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

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

Title		Hrs/wk	СР
Water and Environment: Application and Field Work (L2754) Water and Environment: Theory (L2753)			4
	Lecture	1	2
Prof. Nima Shokri			
None			
After taking part successfully, students hav	e reached the following learning results		
Independent Study Time 124, Study Time ir	n Lecture 56		
6			
None			
Written elaboration			
Report (about 5-10 pages) and Presentatior	(about 15 min)		
Civil Engineering: Specialisation Coastal Eng	gineering: Elective Compulsory		
Civil Engineering: Specialisation Water and	Traffic: Elective Compulsory		
Civil Engineering: Specialisation Coastal Eng	gineering: Elective Compulsory		
Civil Engineering: Specialisation Water and	Traffic: Elective Compulsory		
Environmental Engineering: Specialisation V	Vater: Elective Compulsory		
Environmental Engineering: Specialisation \	Vater: Elective Compulsory		
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• • •			
• • •			
	753)         Prof. Nima Shokri         None         After taking part successfully, students have         Independent Study Time 124, Study Time in         6         None         Written elaboration         Report (about 5-10 pages) and Presentation         Civil Engineering: Specialisation Coastal Eng         Civil Engineering: Specialisation Coastal Eng         Civil Engineering: Specialisation Water and         Civil Engineering: Specialisation Water and         Environmental Engineering: Specialisation Water and         Environmental Engineering: Specialisation Water and         Mater and Environmental Engineering: Specialisation Water and Environmental Engineering: Specialisa	753)       Lecture         Prof. Nima Shokri         None         After taking part successfully, students have reached the following learning results         Independent Study Time 124, Study Time in Lecture 56         6         None	753)       Lecture       1         Prof. Nima Shokri

Course L2754: Water and En	vironment: Application and Field Work
Тур	Project-/problem-based Learning
Hrs/wk	3
СР	4
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42
Lecturer	Anna Luisa Hemshorn de Sánchez, Dr. Salome Shokri-Kuehni
Language	EN
Cycle	SoSe
Content	
Literature	

Course L2753: Water and En	urse L2753: Water and Environment: Theory		
Тур	Lecture		
Hrs/wk	1		
СР	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Nima Shokri		
Language	EN		
Cycle	SoSe		
Content			
Literature			

## Module M0593: Building Materials and Building Preservation

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

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

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

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

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

Courses						
Title		Тур	Hrs/wk	СР		
Design of Prestressed Structures a	nd Concreet Bridges (L0603)	Lecture	3	4		
Design of Prestressed Structures a	nd Concreet Bridges (L0604)	Recitation Section (large)	2	2		
Module Responsible	Prof. Günter Rombach					
Admission Requirements	None					
<b>Recommended Previous</b>	Detailed knowledge on the design of conc	rete structures.				
Knowledge	Modules: Reinforced Concrete Structures I+II, Structural Analysis I+II, Mechanics I+II, Concrete Structures					
Educational Objectives	After taking part successfully, students ha	we reached the following learning results				
Professional Competence						
Knowledge	The students know the main bridge types, their applications and the various loads. They can explain the basic design They can explain the design of a prestressed bridge.					
Skills	The students are able to design reinforced or prestressed concrete bridges.					
Personal Competence						
•	The students can design in teamwork a re	al concrete bridge.				
	-	-				
Autonomy	The students are able to design a prestressed concrete bridge and discuss the problems and results with other students.					
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70				
Credit points						
Course achievement	None					
Examination	Written exam					
Examination duration and	180 minutes					
scale						
Assignment for the	Civil Engineering: Specialisation Structura	l Engineering: Compulsory				
-	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory					
	Civil Engineering: Specialisation Coastal E	ngineering: Elective Compulsory				
	International Management and Engineerin	g: Specialisation II. Civil Engineering: Elective Com	nulcon			

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

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

	lechanics and -D	ynannes						
Courses								
Title			Тур		Hrs/wk	СР		
oil Mechanics - Selected Topics (L	0374)		Lecture		2	2		
Soil Dynamics (L0452)			Lecture		3	2		
Experimental Researches in Geote	hnics (L0706)		Practical	Course	1	2		
Module Responsible	Prof. Jürgen Grabe							
Admission Requirements	None							
<b>Recommended Previous</b>	modules: Mathematics I	-III, Mechanics I-II, Geo	echnics I					
Knowledge	courses: Soil laboratory	course, (Applied struct	ural dynamics)					
Educational Objectives	After taking part succes	sfully, students have re	eached the following learning	ng results				
Professional Competence								
Knowledge	After the successful com	npletion of the module	the students should be able	e to:				
			n of a simple mass oscillato					
			he soil under dynamic exci					
			d tests to determine soil dy	namic characte	eristics and to evaluat	e tnem,		
	to design machine foundations to dynamic load,							
	to measure shocks to perform vibration forecast,							
	<ul> <li>to evaluate shocks in term to their effect on people and buildings,</li> <li>to evaluate possibilities of isolation,</li> </ul>							
						and interaction		
	<ul> <li>to understand mechanisms that cause earthquakes and evaluate earthquake in term of their magnitude and inter</li> </ul>							
		• to know methods to determine axial pile capacity, integrity and the dynamic bedding modulus,						
	<ul> <li>to know the mechanisms that lead to a deformation accumulation due to cyclic loading and to estimate these deformation</li> </ul>							
	<ul><li>mathematically,</li><li>to distinguish the area of application of the method of elastodynamics and plastodynamics,</li></ul>							
	<ul> <li>to distinguish the</li> </ul>	area of application of	the method of elastodynam	lics and plastoo	iynamics,			
	<ul> <li>to dotoct the und</li> </ul>	rained chear strongth	as a function of a number of	f ctato variablo	c			
			as a function of a number o			ant choor strongt		
		sous benaviour of cone	sive soils and to consider t	ne effects of cr	eep and rate-depende	ent snear strengt		
	<ul><li>calculations,</li><li>to consider the impact of the partly saturated of a seepage and shear strength.</li></ul>							
		ilpact of the partiy satt	rated of a seepage and she	ar strengtn.				
Skills								
Personal Competence								
Social Competence								
Autonomy								
Workload in Hours	Independent Study Time	e 96, Study Time in Leo	ture 84					
Credit points	6							
Course achievement		Form	Description					
	Yes 15 % 5	Subject theoretical	and					
	1	oractical work						
Examination	Written exam							
Examination duration and	150 min							
scale								
Assignment for the	Civil Engineering: Specia	alisation Structural Eng	ineering: Elective Compuls	ory				
Following Curricula	Civil Engineering: Specia	alisation Geotechnical I	Engineering: Compulsory					
	Civil Engineering: Specia	alisation Coastal Engine	ering: Elective Compulsory	/				

Course L0374: Soil Mechanics - Selected Topics	
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Hans Mathäus Stanford
Language	DE
Cycle	SoSe
Content	selected topis:
	- continuum mechanis
	- constitutive modelling
	- time and rate dependend material behavior of soils
	- cyclic loading
	- undrained conditions
Literature	Kolymbas D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. Springer Verlag

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

Course L0706: Experimental	Researches in Geotechnics	
Тур	Practical Course	
Hrs/wk	1	
CP	2	
Workload in Hours	ndependent Study Time 46, Study Time in Lecture 14	
Lecturer	Dr. Marius Milatz	
Language	DE	
Cycle	SoSe	
content	<ul> <li>The students are supposed to:</li> <li>become acquainted with geotechnical model tests, field tests and laboratory tests as well as corresponding measurement techniques. These compromise amongst others inclinometer measurements and geophone measurements as well as high-grade laboratory tests on the stress-strain relationship of soil specimens, e. g. triaxial tests, simple shear tests and resonant</li> </ul>	
	<ul> <li>olumn tests.</li> <li>gain insight into current soil mechanical research.</li> <li>plan, coordinate, perform and evaluate soil mechanical tests in a team.</li> <li>discuss, reflect, review and present the obtained results in a group.</li> </ul>	
	An important learning target is the introduction to scientific work for students who plan a scientific career, and for those who will work in practice with the responsibility to order corresponding tests and evaluate the results. The practical laboratory work is based on annualy changing problems, which are however related to the experience and results of the preceding year's course group.	
Literature	- Grabe, J. (2004): Bodenmechanik und Grundbau, Band 3 der Veröffentlichungsreihe des Instituts für Geotechnik und Baubetrieb, Technische Universität Hamburg-Harburg.	
	- Kolymbas, D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. 2., korrigierte und ergänzte Auflage, Springer Verlag.	
	<ul> <li>Normen zu geotechnischen Versuchsgeräten und Versuchsverfahren:</li> <li>DIN 18135:2012-04: Baugrund, Untersuchung von Bodenproben -</li> <li>Eindimensionaler Kompressionsversuch, Deutsches Institut für</li> <li>Normung, e. V.</li> </ul>	
	- DIN 18137-2:2011-04: Baugrund, Untersuchung von Bodenproben - Bestimmung der Scherfestigkeit - Teil 2: Triaxialversuch, Deutsches Institut für Normung e. V.	

Courses				
Title		Тур	Hrs/wk	СР
Boundary Element Methods (L0523	)	Lecture	2	3
Boundary Element Methods (L0524		Recitation Section (large)	2	3
Module Responsible	Prof. Otto von Estorff			
Admission Requirements	None			
<b>Recommended Previous</b>	Mechanics I (Statics, Mechanics of Mate	ials) and Mechanics II (Hydrostatics, Kinematics, E	ynamics)	
Knowledge	Mathematics I, II, III (in particular differe	ntial equations)		
	After taking part successfully, students	any conclude the following learning regults		
	After taking part successfully, students	nave reached the following learning results		
Professional Competence	<b>-</b>			
Knowledge	overview of the theoretical and methodi	ledge regarding the derivation of the boundary e	element method an	d are able to give a
<i>CL 11</i>	<b>-</b>	and the second		
SKIIIS		engineering problems by formulating suitable	e boundary eleme	nts, assembling ti
	corresponding system matrices, and sol	ving the resulting system of equations.		
Personal Competence				
Social Competence	Students can work in small groups on sp	ecific problems to arrive at joint solutions.		
Autonomy The students are able to independently solve challenging computational problems and develop own boundary e		arv element routine		
,	Problems can be identified and the resu			
Workload in Hours	Independent Study Time 124, Study Tim	e in Lecture 56		
Credit points	6			
Course achievement	Compulsory Bonus Form	Description		
	No 20 % Midterm			
Examination				
Examination duration and	90 min			
scale				
-	Civil Engineering: Specialisation Structu			
Following Curricula	Civil Engineering: Specialisation Geotec Civil Engineering: Specialisation Coastal	• • • •		
	Energy Systems: Core Qualification: Electronic Coastantice Systems: Core Qualification: Electronic Systems: Core Syste	• • • •		
		nt: Specialisation Product Development and Produ	ction: Elective Com	oulsory
	Mechatronics: Specialisation System De			
		duction: Core Qualification: Elective Compulsory		
		ngineering Science: Elective Compulsory		
		J J		

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

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

Courses				
Title		Тур	Hrs/wk	СР
Groundwater Modeling using Modflow (L0543)		Lecture	1 2	1 2
Groundwater Modeling using Modfl Modeling of Water Supply and Sew		Recitation Section (small) Project-/problem-based Learning	2	2
Module Responsible			_	-
Admission Requirements	None			
Recommended Previous	Groundwater			
Knowledge				
	groundwater hydraulics and transport of substances			
	Pipe Systems			
	Knowledge on urban water infrastructures, in particular drinking water systemsand urban drainage systems includi			
	special structures			
	Hydraulics of drinking water supply systems ar	id sewer systems		
	Basic knowledge on water management			
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students are able to describe the modelling of groundwater flow and transport as well as urban water infrastructures.			astructures. They o
	carry out systems analyses and can detect technical and conceptual weak points within the systems in case studies. Besides the			
	are able to analyse interdependencies of hydraulic and toxic phenomena in soil and water.			
Skills	The students are able to construct and apply scientific groundwater models indipendently. They can work on different scenario			
	and can compare or assess different solutions for existing problems by application of selected software products. The students ar able to use different software solutions (e.g. EPANET, EPA-SWMM).			
	uble to use different software solutions (e.g. Er Aller,			
Devenuel Compotonico				
Personal Competence	Wird nicht vermittelt.			
Social competence	which ment vermitter.			
Autonomy	Wird nicht vermittelt.			
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Oral exam			
	20 min			
scale				
Assignment for the				
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Civil Engineering: Specialisation Coastal Engineering:	5 1 5		
	Civil Engineering: Specialisation Coastal Engineering: Civil Engineering: Specialisation Water and Traffic: Ele			
	Water and Environmental Engineering: Specialisation			
	Water and Environmental Engineering: Specialisation			
	Water and Environmental Engineering: Specialisation			

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Noise Protection (L1109)		Lecture	2	2
Urban Infrastructures (L0874)		Project-/problem-based Learning	2	4
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
<b>Recommended Previous</b>	Knowledge on Urban planning			
Knowledge	Knowledge on measures for climate protection			
	General knowledge of scientific writing/working			
	General knowledge of sciencing working			
Educational Objectives	After taking part successfully, students have reached the followin	ig learning results		
Professional Competence				
Knowledge	Students can describe urban development corridors as well as cu	urrent and future urban environr	mental probler	ms. They are able
	explain the causes of environmental problems (like noise).			
	Students can specify applications for various technical innovation	ns and explain why these contri	bute to the im	provement of urba
	life. They can, for example, derive and discuss measures for effective noise abatement.			
Skille	<i>Chille</i> Students are able to develop specific colutions for correcting evicting or future equiverment soluted problem		problems of urb	
Skills Students are able to develop specific solutions for correcting existing or future environment-related p development. They can define a range of conceptual and technical solutions for environmental problems for diff		•		
	paths. To solve specific urban environmental problems they can			
	context.		na megrate t	
Personal Competence				
•	The students can work together in international groups.			
Autonomy	Students are able to organize their work flow to prepare themse		ributions to th	ne discussions. Th
	can acquire appropriate knowledge by making enquiries independ	dently.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and				
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Election	ve Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Co	mpulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Comp	oulsory		
	Environmental Engineering: Core Qualification: Elective Compulso	ory		
	Joint European Master in Environmental Studies - Cities and Susta	ainability: Core Qualification: Cor	mpulsory	
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure	e and Mobility: Elective Compuls	ory	
	Water and Environmental Engineering: Specialisation Environmer	at: Elective Compulsory		
	Water and Environmental Engineering. Specialisation Environmen	it. Liective compuisory		

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

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

Courses				
Title		Тур	Hrs/wk	СР
Coastal- and Flood Protection (L08)	)8)	Lecture	2	3
Coastal- and Flood Protection (L14)	.5)	Project-/problem-based Learning	1	1
Maintennance and Defence of Floo	d Protection Structures (L1411)	Lecture	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
<b>Recommended Previous</b>	Coastal Engineering I			
Knowledge				
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
Professional Competence				
Knowledge	The students have the capability to define and e	xplain in detail the important aspects of erosi	on protection	and flood protect
	and are able to apply the aspects to practical coastal protection problems. They are able to design and dimension importan			
	coastal protection measures from the functional a	nd from the constructional point of view.		
Cl://l-	The students are child to call at design any second			
SKIIIS	The students are able to select design approaches for the functional and constructional design of erosion and flood protection measures and apply these approaches to practical design tasks.			
	measures and apply these approaches to practica	i design tasks.		
Personal Competence				
Social Competence	The students are able to deploy their gained know	owledge in applied problems such as the fund	ctional and co	onstructive design
	coastal and flood protection structures. Additional	y, they will be able to work in team with engine	eers of other d	lisciplines.
Autonomy	The students will be able to independently extend	their knowledge and apply it to new problems		
Workload in Hours	Independent Study Time 110, Study Time in Lectu	re 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 130 min. The examination includes tasks with respect to the general understanding of the			
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural Engine	ering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Eng	ineering: Elective Compulsory		
ronowing curricula	5 5 1			

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

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

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

Course L1411: Maintennance	e and Defence of Flood Protection Structures
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Olaf Müller
Language	DE
Cycle	SoSe
Content	<ul> <li>Dike protection</li> <li>Maintennance of flood protection measures</li> </ul>
Literature	Vorlesungsumdruck

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

Тур	Lecture
Hrs/wk	
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	
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

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

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

	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	

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

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

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

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

Module M0874: Waste	ewater Systems			
Courses				
Title		Тур	Hrs/wk	СР
Wastewater Systems - Collection, T	reatment and Reuse (10934)	Lecture	2	2
Wastewater Systems - Collection, T		Recitation Section (large)	1	1
Advanced Wastewater Treatment (	L0357)	Lecture	2	2
Advanced Wastewater Treatment (	_0358)	Recitation Section (large)	1	1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
<b>Recommended Previous</b>	Knowledge of wastewater management and	d the key processes involved in wastewater trea	tment.	
Knowledge				
Educational Objectives	After taking part successfully, students hav	e reached the following learning results		
Professional Competence				
Knowledge	Students are able to outline key areas of th	ne full range of treatment systems in waste wat	er management, as	s well as their mut
	dependence for sustainable water protectio	on. They can describe relevant economic, enviro	nmental and social	factors.
Skills		in the available wastewater treatment process	es and the scope of	of their application
	municipal and for some industrial treatment	t plants.		
Personal Competence				
	Social skills are not targeted in this module.			
boeiar competence				
Autonomy	Students are in a position to work on a s	subject and to organize their work flow indepe	ndently. They can	also present on t
	subject.			
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural I	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnic	cal Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Eng	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and	Traffic: Compulsory		
	Bioprocess Engineering: Specialisation A - C	General Bioprocess Engineering: Elective Compu	llsory	
	Environmental Engineering: Specialisation \	Water: Elective Compulsory		
	International Management and Engineering	: Specialisation II. Process Engineering and Biot	echnology: Elective	Compulsory
	International Management and Engineering	: Specialisation II. Energy and Environmental Er	gineering: Elective	Compulsory
	Process Engineering: Specialisation Environ	mental Process Engineering: Elective Compulso	ry	
	Process Engineering: Specialisation Process	s Engineering: Elective Compulsory		
	Water and Environmental Engineering: Spec	cialisation Water: Compulsory		
	Water and Environmental Engineering: Spe	cialisation Environment: Elective Compulsory		

## Course L0934: Wastewater Systems - Collection, Treatment and Reuse

Тур	Lecture	
Hrs/wk	2	
СР		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Prof. Ralf Otterpohl	
Language	EN	
Cycle	SoSe	
Content	•Understanding the global situation with water and wastewater	
	•Regional planning and decentralised systems	
	•Overview on innovative approaches	
	•In depth knowledge on advanced wastewater treatment options for different situations, for end-of-pipe and reuse	
	Mathematical Modelling of Nitrogen Removal	
	•Exercises with calculations and design	
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 S	urse L0943: Wastewater Systems - Collection, Treatment and Reuse		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Ralf Otterpohl		
Language	EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

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

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

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

Course L1066: City Planning	
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Carsten Gertz
Language	DE
Cycle	SoSe
Content	"Principles of Urban Planning" deals with the determinants of urban development and their interactions. Topics include:
	<ul> <li>legal framework,</li> <li>instruments and methods of planning,</li> <li>functional requirements,</li> <li>stakeholders and actors</li> <li>basic design requirements</li> <li>different planning levels and</li> <li>historical contexts.</li> </ul> The objective of the course is for students to acquire a basic understanding of urban development problems and approaches for solving them. They will also be able to comprehend the process of urban planning. The course also covers the various functional and aesthetic requirements for designing streetscape as the most important elements of public space. The project work deals with a real life scenario and includes drawing up a development plan, an urban design concept, a building masterplan and a street redesign.
Literature	Albers, Gerd; Wekel, Julian (2009) Stadtplanung: Eine illustrierte Einführung. Primus Verlag. Darmstadt. Frick, Dieter (2008) Theorie des Städtebaus: Zur baulich-räumlichen Organisation von Stadt. Wasmuth-Verlag. Tübingen
	They, Dieter (2000) meane des Stautebaus. Zur baunchmauminen organisation von Staut. Washluth-Verlag. Tubingen
	Jonas, Carsten (2009) Die Stadt und ihr Grundriss. Wasmuth-Verlag. Tübingen
	Kostof, Spiro; Castillo, Greg (1998) Die Anatomie der Stadt. Geschichte städtischer Strukturen. Campus-Verlag. Frankfurt/New York.

Courses				
Title	Тур	1	Hrs/wk	СР
Construction Logistics (L1163)	Lectu		1	2
Construction Logistics (L1164)		tation Section (small)	1	2
Project Development and Management (L1161) Lecture Project Development and Management (L1162) Project-/problem-ba			1	1
		sct-/problem-based Learning	1	1
Module Responsible	-			
Admission Requirements				
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following lea	arning results		
Professional Competence				
Knowledge	Students can			
	• give definitions of the main terms of construction logistics and	project development and m	anagement	
	name advantages and disadvantages of internal or external con	nstruction logistics		
	• explain characteristics of products, demand and production of	construction objects and the	eir consequer	nces for construction
	specific supply chains			
	differentiate constructions logistics from other logistics systems	S		
CL ///-				
Skills	Students can			
	carry out project life cycle assessments			
	apply methods and instruments of construction logistics			
	apply methods and instruments of project development and ma	anagement		
	<ul> <li>apply methods and instruments of conflict management</li> </ul>			
	design supply and waste removal concepts for a construction p	project		
Personal Competence				
Social Competence	Students can			
	<ul> <li>hold presentations in and for groups</li> </ul>			
	<ul> <li>apply methods of conflict solving skills in group work and cases</li> </ul>	studies		
Autonomy	Students can			
	solve problems by holistic, systemic and flow oriented thinking			
	<ul> <li>improve their creativity, negotiation skills, conflict and crises</li> </ul>		methods of	moderation in ca
	studies			
	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement				
Examination	Written elaboration			
	Two written papers with presentations			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Comp	pulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Co			
	Civil Engineering: Specialisation Coastal Engineering: Elective Comput			
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsor	ry		
	International Management and Engineering: Specialisation II. Civil Eng	jineering: Elective Compulso	ory	
	International Management and Engineering: Specialisation II. Logistics			
	Logistics, Infrastructure and Mobility: Specialisation Production and Lo	gistics: Elective Compulsory	/	
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and	Mobility: Elective Compuls	orv	

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

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

Course L1161: Project Devel	opment and Management
Тур	Lecture
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Heike Flämig, Dr. Anton Worobei
Language	DE
Cycle	SoSe
Content	<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> <li>Contents of the lecture are deepened in special exercises.</li> </ul>
Literature	Projektmanagement-Fachmann. Band 1 und Band 2. RKW-Verlag, Eschborn, 2004.

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

	cs and Dynamics of Structure			
Courses				
Title		Тур	Hrs/wk	СР
Structural Dynamics (L1202)		Lecture	2	2
Structural Dynamics (L1203)		Recitation Section (large)	2	2
Fracture mechanics and fatigue in steel structures (L0564)		Lecture	1	1
Fracture mechanics and fatigue in	steel structures (L0565)	Recitation Section (large)	1	1
Module Responsible	Prof. Uwe Starossek			
Admission Requirements	None			
<b>Recommended Previous</b>	Knowledge of linear structural analysis	of statically determinate and indeterminate structu	ires; Mechanics	I/II, Mathematics
	Differential equations I			
-				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Knowledge	After successful completion of this mode	ule, the student can explain the basic aspects of dy	namic effects o	on structures and
	respective methods.			
<i></i>			<i>.</i>	
Skills		dule, the students will be able to predict the resp	ponse of materi	ial and structures
	dynamics loading using the appropriate of	computational approaches and methods.		
Personal Competence	5			
Social Competence	Students can			
,				
	• participate in subject-specific and			
	<ul><li>participate in subject-specific and</li><li>defend their own work results in fr</li></ul>	ont of others		
	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific development</li> </ul>	ont of others at of colleagues		
	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific development</li> </ul>	ont of others		
	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and action</li> </ul>	ont of others at of colleagues ccept professional constructive criticism	poly it to new pr	ablams Eurthermo
	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> </ul>	ont of others at of colleagues cept professional constructive criticism he subject area from given and other sources and ap	oply it to new pro	oblems. Furthermo
	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> </ul>	ont of others at of colleagues ccept professional constructive criticism	oply it to new pro	oblems. Furthermo
Autonomy	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> </ul>	ont of others at of colleagues ccept professional constructive criticism he subject area from given and other sources and ap ocess for problems in the area of Structural Analysis.	oply it to new pro	oblems. Furthermo
Autonomy Workload in Hours	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> <li>they are able to structure the solution pro-</li> <li>Independent Study Time 96, Study Time</li> </ul>	ont of others at of colleagues ccept professional constructive criticism he subject area from given and other sources and ap ocess for problems in the area of Structural Analysis.	oply it to new pro	oblems. Furthermo
Autonomy Workload in Hours Credit points	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> <li>they are able to structure the solution pro</li> <li>Independent Study Time 96, Study Time</li> <li>6</li> </ul>	ont of others at of colleagues ccept professional constructive criticism he subject area from given and other sources and ap ocess for problems in the area of Structural Analysis.	oply it to new pro	oblems. Furthermo
Autonomy Workload in Hours Credit points Course achievement	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and act</li> <li>Students are able to gain knowledge of t</li> <li>they are able to structure the solution pros</li> <li>Independent Study Time 96, Study Time</li> <li>6</li> <li>None</li> </ul>	ont of others at of colleagues ccept professional constructive criticism he subject area from given and other sources and ap ocess for problems in the area of Structural Analysis.	oply it to new pro	oblems. Furthermo
Autonomy Workload in Hours Credit points Course achievement Examination	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and act</li> <li>Students are able to gain knowledge of t</li> <li>they are able to structure the solution pro</li> <li>Independent Study Time 96, Study Time</li> <li>6</li> <li>None</li> <li>Written exam</li> </ul>	ont of others at of colleagues ccept professional constructive criticism he subject area from given and other sources and ap ocess for problems in the area of Structural Analysis.	oply it to new pro	oblems. Furthermo
Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> <li>they are able to structure the solution pro</li> <li>Independent Study Time 96, Study Time</li> <li>6</li> <li>None</li> <li>Written exam</li> <li>150 min</li> </ul>	ont of others at of colleagues ccept professional constructive criticism he subject area from given and other sources and ap ocess for problems in the area of Structural Analysis.	oply it to new pro	oblems. Furthermo
Autonomy Workload in Hours Credit points Course achievement Examination	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> <li>they are able to structure the solution pro</li> <li>Independent Study Time 96, Study Time</li> <li>6</li> <li>None</li> <li>Written exam</li> <li>150 min</li> </ul>	ont of others at of colleagues ccept professional constructive criticism he subject area from given and other sources and ap ocess for problems in the area of Structural Analysis.	oply it to new pro	oblems. Furthermo
Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> <li>they are able to structure the solution pro</li> <li>Independent Study Time 96, Study Time</li> <li>6</li> <li>None</li> <li>Written exam</li> <li>150 min</li> </ul>	ont of others at of colleagues scept professional constructive criticism he subject area from given and other sources and ap ocess for problems in the area of Structural Analysis. in Lecture 84	oply it to new pro	oblems. Furthermo
Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> <li>they are able to structure the solution pro</li> <li>Independent Study Time 96, Study Time</li> <li>6</li> <li>None</li> <li>Written exam</li> <li>150 min</li> <li>Civil Engineering: Specialisation Structure</li> </ul>	ont of others It of colleagues Iccept professional constructive criticism he subject area from given and other sources and ap ocess for problems in the area of Structural Analysis. in Lecture 84 al Engineering: Compulsory	oply it to new pro	oblems. Furthermo
Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> <li>they are able to structure the solution pro</li> <li>Independent Study Time 96, Study Time</li> <li>6</li> <li>None</li> <li>Written exam</li> <li>150 min</li> <li>Civil Engineering: Specialisation Structure</li> </ul>	ont of others It of colleagues Iccept professional constructive criticism he subject area from given and other sources and ap ocess for problems in the area of Structural Analysis. in Lecture 84 al Engineering: Compulsory nical Engineering: Elective Compulsory	oply it to new pro	oblems. Furthermo
Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> <li>they are able to structure the solution pro</li> <li>Independent Study Time 96, Study Time</li> <li>6</li> <li>None</li> <li>Written exam</li> <li>150 min</li> <li>Civil Engineering: Specialisation Structura</li> </ul>	ont of others It of colleagues It of colleague	oply it to new pro	oblems. Furthermo

Course L1202: Structural Dy	namics
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	SoSe
Content	<ul> <li>Single-degree-of-freedom systems: undamped and damped vibration, free vibration, forced vibrations due to harmonic, periodical or arbitrary loading, natural frequency, damping</li> <li>vibration isolation</li> <li>solution in the frequency-domain (Fourier transformation), solution in the time-domain</li> <li>multi-degree-of-freedom systems: continuous or discrete systems, modelling with finite elements, generalisation</li> <li>modal analysis</li> <li>power iteration according to v.Mises</li> <li>earthquake loading: seismological basics, response spectrum method</li> <li>wind-induced vibrations: engineering meteorology, aerodynamic, classification of excitation mechanisms</li> </ul>
Literature	Clough, R.W., Penzien, J.: Dynamics of Structures. 2. Aufl., McGraw-Hill, New York, 1993.

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

Тур	Lecture
Hrs/wk	1
CP	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Jürgen Priebe
Language	DE
Cycle	SoSe
Content	<ul> <li>basics of fatigue stress and fatigue resistance and determination of fatigue strength,</li> </ul>
	<ul> <li>determination and use of S-N-curves and classification of notch effects,</li> </ul>
	set up of determination of fatigue strength under dynamic load using the accumulation formula by Palmgren-Miner,
	set up of determination of fatigue strength in different examples,
	<ul> <li>basics of construction and design regarding the problem of material fatigue,</li> </ul>
	basics of linear elastic fracture mechanics under static and dynamic load,
	<ul> <li>determination of lifetime of steel construction based on linear elastic fracture mechanics in different examples.</li> </ul>
Literature	Seeßelberg, C.; Kranbahnen - Bemessung und konstruktive Gestaltung; 3. Auflage; Bauwerk-Verlag; Berlin 2009
	Kuhlmann, Dürr, Günther; Kranbahnen und Betriebsfestigkeit; in Stahlbau Kalender 2003; Verlag Ernst & Sohn; Berlin 2003
	Deutscher Stahlbau-Verband (Hrsg.); Stahlbau Handbuch Band 1 Teil B; 3. Auflage; Stahlbau-Verlagsgesellschaft; Köln 199
	Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993
	<ul> <li>DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsreg</li> <li>Bemessungsregeln f         ür den Hochbau; 1993</li> </ul>
	DIN V ENV 1993-6: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 6: Kranbahnen; 2001
	• DIN-Fachbericht 126. Richtlinie zur Anwendung von DIN V ENV 1993-6; Nationales Anwendungsdokument (NAD); Berlin 200

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

Courses				
Title		Тур	Hrs/wk	СР
Steel Construction Project (L1206)		Project Seminar	4	6
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
<b>Recommended Previous</b>	Steel and Composite Structures			
Knowledge				
Educational Objectives	After taking part successfully, students have re	eached the following learning results		
Professional Competence				
Knowledge	Students are able to prepare a part of the who	le project and explain it to the others.		
Skills	s Students can produce sketches and calculations of their part of the project. They are able to adjust their work in re			work in reaction
	changing conditions resulting from other partic	cipants of the project.		
Personal Competence				
Social Competence	Students can present their results to other me	mbers of the group.		
	They have the ability to work for a broad agree	ement with respect to intergroup depende	ncies.	
	They can distribute and process tasks indepen	dently.		
Autonomy	Students can handle their part of the project o	n their own resposibility-		
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	approx. 15-20 pages (without appendix)			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnical	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Engine	eering: Elective Compulsory		
	Civil Engineering: Specialisation Structural Eng	ineerina: Compulsory		

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

Courses				
Title		Тур	Hrs/wk	СР
Marine Geotechnics (L0548)		Lecture	1	2
Marine Geotechnics (L0549)		Recitation Section (large)	2	2
Steel Structures in Foundation and	Hydraulic Engineering (L1146)	Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>	complete modules: Geotechnics I-III, Mathem	atics I-III		
Knowledge	courses Call laboratory course			
	courses: Soil laboratory course			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnical Engineering: Compulsory			
Following Curricula	Civil Engineering: Specialisation Structural Er	igineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engi	neering: Compulsory		
	Theoretical Mechanical Engineering: Specialis	sation Maritime Technology: Elective Compulsory	1	
	Water and Environmental Engineering: Speci			
	Water and Environmental Engineering: Speci-			
	Water and Environmental Engineering: Speci	alisation Water: Elective Compulsory		

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

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

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

-				
Courses Fitle		Typ	Hrs/wk	СР
Port Logistics (L0686)		<b>Typ</b> Lecture	2	3
Port Logistics (L1473)		Recitation Section (small)	2	3
Module Responsible	Prof. Carlos Jahn			
Admission Requirements				
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ched the following learning results		
Professional Competence				
Knowledge	Th			
	After completing the module, students can			
	After completing the module, students can			
	<ul> <li>reflect on the development of seaports (in</li> </ul>	terms of the functions of the ports and the c	orresponding ter	minals, as well as t
	relevant operator models) and place them			
		of seaport terminals and their specific of	characteristics (	cargo, transhipme
	technologies, logistic functional areas);			mainele end devel
		rth planning, stowage planning, yard plannir	ng) at seaport te	rminals and devel
	suitable approaches (in terms of methods identify future developments and trends	regarding the planning and control of inno	vative ceaport to	arminals and discu
	them in a problem-oriented manner.	regarding the planning and control of nino	valive scapore a	
	them in a problem oriented mainler.			
Skills	After completing the module, students will be ab	le to		
	<ul> <li>recognize functional areas in ports and se</li> </ul>			
	define and evaluate suitable operating system			
	<ul> <li>perform static calculations with regard to given boundary conditions, e.g. required capacity (parking spaces, equipmen requirements, guay wall length, part access) on calested terminal types;</li> </ul>			
	<ul> <li>requirements, quay wall length, port access) on selected terminal types;</li> <li>reliably estimate which boundary conditions influence common logistics indicators in the static planning of selected terminal</li> </ul>			
	types and to what extent.			of selected termin
	cypes and to what extent.			
Personal Competence				
Social Competence	After completing the module, students can			
	<ul> <li>transfer the acquired knowledge to furthe</li> </ul>	r questions of port logistics;		
	discuss and successfully organize extensiv	ve task packages in small groups;		
	<ul> <li>in small groups, document work results in</li> </ul>	writing in an understandable form and prese	nt them to an ap	propriate extent.
Autonomy	After completing the module, the students are al	ble to		
	<ul> <li>research and select specialist literature.</li> </ul>	including standards, guidelines and journal	papers, and to c	levelop the conten
	independently;			
	• submit own parts in an extensive written	elaboration in small groups in due time and	to present them	jointly within a fixe
	time frame.			
Workload in Hours	Independent Study Time 124, Study Time in Lect	ture 56		
Credit points				
Course achievement	Compulsory Bonus Form	Description		
	No 15 % Written elaboration			
Examination	Written exam			
Examination duration and	120 minutes			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Enginee	ring: Elective Compulsory		
	International Management and Engineering: Spe	cialisation II. Logistics: Elective Compulsory		
Following Curricula	Following Curricula International Management and Engineering: Specialisation II. Logistics: Elective Compulsory Logistics, Infrastructure and Mobility: Specialisation Production and Logistics: Elective Compulsory			
Following Curricula		ion Production and Logistics: Elective Compu	sory	
Following Curricula		•	-	
Following Curricula	Logistics, Infrastructure and Mobility: Specialisat	ion Infrastructure and Mobility: Elective Comp Systems: Elective Compulsory	-	

Course L0686: Port Logistics	
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Carlos Jahn
Language	DE
Cycle	SoSe
Content	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
	<ul> <li>Fundamentals of different terminals, characteristical layouts and the technical equipment used</li> <li>Handling of current issues in port logistics</li> </ul>
Literature	<ul> <li>Alderton, Patrick (2013). Port Management and Operations.</li> <li>Biebig, Peter and Althof, Wolfgang and Wagener, Norbert (2017). Seeverkehrswirtschaft: Kompendium.</li> <li>Brinkmann, Birgitt. Seehäfen: Planung und Entwurf. Berlin Heidelberg: Springer-Verlag, 2005.</li> <li>Büter, Clemens (2013). Außenhandel: Grundlagen internationaler Handelsbeziehungen.</li> <li>Gleissner, Harald and Femerling, J. Christian (2012). Logistik: Grundlagen, Übungen, Fallbeispiele.</li> <li>Jahn, Carlos; Saxe, Sebastian (Hg.). Digitalization of Seaports - Visions of the Future, Stuttgart: Fraunhofer Verlag, 2017.</li> <li>Kummer, Sebastian (2019). Einführung in die Verkehrswirtschaft</li> <li>Lun, Y.H.V. and Lai, KH. and Cheng, T.C.E. (2010). Shipping and Logistics Management.</li> <li>Woitschützke, Claus-Peter (2013). Verkehrsgeografie.</li> </ul>

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

Courses				
		<b>T</b>	Hue (colo	CD.
<b>Title</b> Maritime Transport (L0063)		<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 3
Maritime Transport (L0003) Maritime Transport (L0064)		Recitation Section (small)	2	3
Module Responsible	Prof Carlos Jahn			
Admission Requirements	None			
Recommended Previous	None			
Knowledge				
5	After taking part successfully, students have reached th	e following learning results		
Professional Competence	The fulling part successionly, stadents have reached in			
	The students are able to			
5				
	present the actors involved in the maritime trans			
	<ul> <li>name common cargo types in shipping and class</li> </ul>			
	explain operating forms in maritime shipping, tra			
	weigh the advantages and disadvantages of the			
	<ul> <li>present relevant factors for the location plannin wave</li> </ul>	ig of ports and seaport terminals and	discuss them in	a problem-orient
	<ul><li>way;</li><li>estimate the potential of digitisation in maritime</li></ul>	chinning		
		snipping.		
Skills	The students are able to			
	determine the mode of transport, actors and fun			
<ul> <li>identify possible cost drivers in a transport chain and recommend appropriate proposals for cost reduction;</li> </ul>				
	<ul> <li>record, map and systematically analyse material and information flows of a maritime logistics chain, ident problems and recommend solutions;</li> <li>perform risk assessments of human disruptions to the supply chain;</li> <li>analyse accidents in the field of maritime logistics and evaluating their relevance in everyday life;</li> </ul>			in, identity possi
	<ul> <li>deal with current research topics in the field of m</li> </ul>			
	<ul> <li>apply different process modelling methods in a h</li> </ul>			pective advantag
		-		
Personal Competence				
Social Competence	The students are able to			
	<ul> <li>discuss and organise extensive work packages ir</li> </ul>	groups;		
	<ul> <li>document and present the elaborated results.</li> </ul>			
Autonomy	The students are capable to			
	<ul> <li>research and select technical literature, including</li> </ul>	standards and guidelines;		
	submit own shares in an extensive written elabor	ation in small groups in due time.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement		ription		
	No 15 % Subject theoretical and Teil	nahme an einem Planspiel und anschlie	eßende schriftlich	e Ausarbeitung
	practical work			
Examination	Written exam			
Examination duration and				
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: E	ective Compulsory		
Following Curricula	International Management and Engineering: Specialisat			
<b>3</b>	Logistics, Infrastructure and Mobility: Specialisation Pro		sory	
	Logistics, Infrastructure and Mobility: Specialisation Infr	•	-	
	Renewable Energies: Specialisation Wind Energy System			
	Theoretical Mechanical Engineering: Specialisation Mari			

Course L0063: Maritime Tran	isport
Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Carlos Jahn
Language	DE
Cycle	SoSe
Content	The general tasks of maritime logistics include the planning, design, implementation and control of material and information flows in the logistics chain ship - port - hinterland. This includes technology assessment, selection, dimensioning and implementation as well as the operation of technologies. The aim of the course is to provide students with knowledge of maritime transport and the actors involved in the 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: Maritime Tran	isport
Тур	Recitation Section (small)
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Carlos Jahn
Language	DE
Cycle	SoSe
Content	The exercise lesson bases on the haptic management game MARITIME. MARITIME focuses on providing knowledge about structures and processes in a maritime transport network. Furthermore, the management game systematically provides process management methodology and also promotes personal skills of the participants.
Literature	<ul> <li>Stopford, Martin. Maritime Economics Routledge, 2009</li> <li>Brinkmann, Birgitt. Seehäfen: Planung und Entwurf. Berlin Heidelberg: Springer-Verlag, 2005.</li> <li>Schönknecht, Axel. Maritime Containerlogistik: Leistungsvergleich von Containerschiffen in intermodalen Transportketten. Berlin Heidelberg: Springer-Verlag, 2009.</li> </ul>

Courses				
		<b>T</b>	Use tools	<b>CD</b>
<b>Title</b> Smart Monitoring (L2762)		Typ Integrated Lecture	Hrs/wk 2	<b>CP</b> 2
Smart Monitoring (L2763)		Recitation Section (small)	2	4
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
	Basic knowledge or interest in object-oriented modeling, p	rogramming, and sensor technol	ogies are helpful	l. Interest in mode
	research and teaching areas, such as Internet of Things, In skills of scientific working, are required. Basic knowledge in	dustry 4.0 and cyber-physical sy	stems, as well a	
Educational Objectives	After taking part successfully, students have reached the fol	lowing learning results		
Professional Competence				
	The students will become familiar with the principles and decentralized smart systems to be applied for continuou environment. In addition, the students will learn to design a analysis techniques, modern software design concepts, and also part of this module. In small groups, the students "intelligent" sensors to be implemented by the students. techniques. The smart monitoring systems will be mounted on scaled lab structures for validation purposes. The outcom module will "automatically" participate with their smart moritten papers and oral examinations form the final grades.	is (remote) monitoring of syste nd to implement intelligent sense embedded computing methodolo will design smart monitoring s . Specific focus will be put on on real-world (built or natural) sy me of every group will be docum ionitoring system in the annual	ms in the built or systems using gies. Besides lect ystems that inte the application ystems, such as ented in a paper "Smart Monitorir	and in the natu state-of-the-art da tures, project work egrate a number of machine learn bridges or slopes, c. All students of t ng" competition.
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	10 pages of work with 15-minute oral presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Traffic: Elective C	Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: E	lective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Electiv	e Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elec			
	Civil Engineering: Specialisation Coastal Engineering: Electiv	e Compulsory		
	Civil Engineering: Specialisation Geotechnical Engineering: E	lective Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elec	tive Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective C	1 5		
	Environmental Engineering: Specialisation Waste and Energy	y: Elective Compulsory		
	Environmental Engineering: Specialisation Biotechnology: Ele	ective Compulsory		
	Environmental Engineering: Specialisation Water: Elective Co			
	Environmental Engineering: Specialisation Waste and Energy	y: Elective Compulsory		
	Environmental Engineering: Specialisation Biotechnology: Ele			
	Environmental Engineering: Specialisation Water: Elective Co			
	Water and Environmental Engineering: Specialisation Cities:			
	Water and Environmental Engineering: Specialisation Cities:			
	Water and Environmental Engineering: Specialisation Environ			
	Water and Environmental Engineering: Specialisation Environ			
	Water and Environmental Engineering: Specialisation Water:	Elective Compulsory		
	Water and Environmental Engineering: Specialisation Water:			

Course L2762: Smart Monito	ring
Тур	Integrated Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	In this course, principles of smart monitoring will be taught, focusing on modern concepts of data acquisition, data storage, and data analysis. Also, fundamentals of intelligent sensors and embedded computing will be illuminated. Autonomous software and decentralized data processing are further crucial parts of the course, including concepts of the Internet of Things, Industry 4.0 and cyber-physical systems. Furthermore, measuring principles, data acquisition systems, data management and data analysis algorithms will be discussed. Besides the theoretical background, numerous practical examples will be shown to demonstrate how smart monitoring may advantageously be used for assessing the condition of systems in the built or natural environment.
Literature	

Course L2763: Smart Monito	ring
Тур	Recitation Section (small)
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	The contents of the exercises are based on the lecture contents. In addition to the exercises, project work will be conducted, which will consume the majority of the workload. As part of the project work, students will design smart monitoring systems that will be tested in the laboratory or in the field. As mentioned in the module description, the students will participate in the "Smart Monitoring" competition, hosted annually by the Institute of Digital and Autonomous Construction. Students are encouraged to contribute their own ideas. The tools required to implement the smart monitoring systems will be taught in the group exercises as well as through external sources, such as video tutorials and literature.
Literature	

Courses				
Title		Тур	Hrs/wk	СР
Water Protection and Wastewater I	-	Lecture	3	3
Water Protection and Wastewater I	5	Project Seminar	3	3
Module Responsible				
Admission Requirements	None			
Recommended Previous	Basic knowledge in water managem	ent:		
Knowledge	<ul> <li>Good knowledge in urban drainage;</li> </ul>			
	<ul> <li>Good knowledge of wastewater treat</li> </ul>	tment techniques;		
	Good knowledge of pollutants (e.g.	COD, BOD, TS, N, P) and their properties;		
		and the first fills of the sector sector		
	After taking part successfully, students have	ve reached the following learning results		
Professional Competence	The students can describe the basis arises		- internetional and Ex	
Knowledge		ples of the regulatory framework related to th substance cycles and water morphology ir		
		ch as ecosystem service and wastewater tre	-	
	solutions, remediation measures as well as		atment with a special	
Skills		oblems and situations in a country-specific o		
		tomorrow's urban water cycle. Furthermore	, they can suggest a	ppropriate techni
	administrative and legislative solutions to	solve these problems.		
Personal Competence				
Social Competence	The students can work together in internat	tional groups.		
Autonomy	-	low to prepare presentations and discussions	s. They can acquire ap	propriate knowled
	by making enquiries independently.			
Workload in Hours	Independent Study Time 96, Study Time in	Locture 94		
Credit points				
Course achievement				
Examination				
Examination duration and	Term paper plus presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structural	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechni	• • • • •		
	Civil Engineering: Specialisation Coastal Er			
	Civil Engineering: Specialisation Water and			
	Environmental Engineering: Specialisation			
		g: Specialisation II. Civil Engineering: Elective		
	Joint Europoon Master in Environment of Cl	udion Citize and Custainability Constall'		
		udies - Cities and Sustainability: Specialisation	n Water: Elective Comp	oulsory
	Joint European Master in Environmental St Water and Environmental Engineering: Spe Water and Environmental Engineering: Spe	ecialisation Cities: Elective Compulsory	n Water: Elective Comp	bulsory

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

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

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

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

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

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

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

Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978	Course L0577: Structural Co	ncrete Members
CP       3         Workload in Hours       Independent Study Time 62, Study Time in Lecture 28         Lecturer       Prof. Günter Rombach         Language       DE         Cycle       WiSe         Content       • skyscrapers: structural elements         • actions on structrues       • bracing systems         • design off slabs (line and point supported plates and floor slabs)       • membranes and deep beams         • folded plates and shells       • truss models         • reinforced and prestressed members         Literature       Vorlesungsunterlagen können im STUDIP heruntergeladen werden         • Zlich K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010         • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003         • Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005         • Deutscher Ausschuss für Stahlbeton: Heft 200: Elfäuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012         • Deutscher Ausschuss für Stahlbeton: Heft 200: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken. Verlag Ernst & Sohn, Berlin 1978         • Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil 1, 287-366, Verlag Ernst & Sohn, Berlin 1992         • Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin 1973	Тур	Lecture
Workload in Hours         Independent Study Time 62, Study Time in Lecture 28           Lecturer         Prof. Günter Rombach           Language         DE           Cycle         WiSe           Content         • skyscrapers: structural elements • actions on structrues • bracing systems • design orf slabs (line and point supported plates and floor slabs) • membranes and deep beams • folded plates and shells • truss models • reinforced and prestressed members           Literature         Vorlesungsunterlagen können im STUDiP heruntergeladen werden • Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003 • Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktiven Ingenieurbau. Springer, Heidelberg 2010 • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003 • Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 • Deutscher Ausschuss für Stahlbeton: Heft 600: Erfäuterungen zu DIN EN 1992-1-1. Beuth Verlag, Berlin 2012 • Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 • Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin, 1973 • Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin, 1992 • Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin, 1973 • Stiglat/Wippel: Naten. Verlag Ernst & Sohn, Berlin, 1973 • Schlaich J.: Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, 5. 721ff, Verlag Ernst & S	Hrs/wk	2
Lecturer       Prof. Günter Rombach         Language       DE         Cycle       WiSe         Content       • skyscrapers: structural elements         • actions on structrues       • bracing systems         • design of slabs (line and point supported plates and floor slabs)         • membranes and deep beams         • folded plates and shells         • truss models         • reinforced and prestressed members         Literature         Vorlesungsunterlagen können im STUDIP heruntergeladen werden         • Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010         • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003         • Phocas, Marios C.: Hochhäuser is Stahlbeton: Heft 600: Erläustruturungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012         • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläustruturungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012         • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläustruterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012         • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläustruterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012         • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläustruterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012         • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläustruterungen zu Berechnung der Schnittgrößen und Formänderungen von	CP	3
Language         DE           Cycle         WiSe           Content         • skyscrapers: structural elements           • actions on structrues         • bracing systems           • design orf slabs (line and point supported plates and floor slabs)         • membranes and deep beams           • folded plates and shells         • truss models           • truss models         • reinforced and prestressed members           Literature         Vorlesungsunterlagen können im STUDIP heruntergeladen werden           • Zlich K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010           • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003           • Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005           • Deutscher Ausschuss für Stahlbeton: Heft 200: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012           • Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978           • Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992           • Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin 1973           • Schlaich J.; Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst & Sohn, Berlin, 1998	Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Cycle         WiSe           Content         • skyscrapers: structural elements           • actions on structrues         • bracing systems           • design orf slabs (line and point supported plates and floor slabs)         • membranes and deep beams           • folded plates and shells         • truss models           • reinforced and prestressed members           Literature         Vorlesungsunterlagen können im STUDiP heruntergeladen werden           • Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010           • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003           • Phocas, Marios C.: Hochhäuser is Tragwerk und Konstruktiva, Stuttgart, Teubner, 2005           • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012           • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012           • Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978           • Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992           • Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin 1973           • Schlaich J.: Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Er	Lecturer	Prof. Günter Rombach
Content       • skyscrapers: structural elements         • actions on structrues       • bracing systems         • design orf slabs (line and point supported plates and floor slabs)         • membranes and deep beams         • folded plates and shells         • truss models         • reinforced and prestressed members         Literature         Vorlesungsunterlagen können im STUDiP heruntergeladen werden         • Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010         • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003         • Phocas, Marios C.: Hochhäuser aus Stahlbeton, Betonkstruktiven, Teubner, 2005         • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012         • Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978         • Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1973         • Schlaich J.; Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst & Sohn, Berlin, 1978	Language	DE
<ul> <li>skyscrapers: structural elements</li> <li>actions on structrues</li> <li>bracing systems</li> <li>design orf slabs (line and point supported plates and floor slabs)</li> <li>membranes and deep beams</li> <li>folded plates and shells</li> <li>truss models</li> <li>reinforced and prestressed members</li> </ul> Literature Vorlesungsunterlagen können im STUDiP heruntergeladen werden <ul> <li>Zlich K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010</li> <li>König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst &amp; Sohn, Berlin 2003</li> <li>Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 <ul> <li>Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012</li> <li>Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012</li> <li>Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen von Stahlbetontragwerken, Verlag Ernst &amp; Sohn, Berlin 1978</li> <li>Stiglat, K., Wippel, H.: Massive Platten - Ausgewählt Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst &amp; Sohn, Berlin 1992</li> <li>Stiglat, K., Wippel, Platten. Verlag Frinst &amp; Sohn, Berlin 1992</li> <li>Stiglat/Wippel: Platten. Verlag Frinst &amp; Sohn, Berlin 1993</li> <li>Schlaich J.; Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst &amp; Sohn, Berlin, 1998</li> </ul></li></ul>	Cycle	WiSe
	Content	<ul> <li>skyscrapers: structural elements <ul> <li>actions on structrues</li> <li>bracing systems</li> <li>design orf slabs (line and point supported plates and floor slabs)</li> <li>membranes and deep beams</li> <li>folded plates and shells</li> <li>truss models</li> <li>reinforced and prestressed members</li> </ul> </li> <li>Vorlesungsunterlagen können im STUDiP heruntergeladen werden</li> <li>Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010</li> <li>König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst &amp; Sohn, Berlin 2003</li> <li>Phocas, Marios C.: Hochhäuser aus Stahlbeton: Retonkalender 2003, Teil II, Seite 1-69, Verlag Ernst &amp; Sohn, Berlin 2003</li> <li>Phocas, Marios C.: Hochhäuser aus 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, 1973</li> </ul>

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

Courses						
Fitle			Тур	al Course	Hrs/wk 2	<b>CP</b> 2
Naste and Environmental Chemistr Biological Waste Treatment (L0318	-			t-/problem-based Learning	2	4
Module Responsible			- )	,,		
Admission Requirements						
Recommended Previous		al basics				
Knowledge	chemical and biologic					
Educational Objectives	After taking part succ	essfully, students have r	eached the following lear	ning results		
Professional Competence	, and taking part bace					
Knowledge	design and layout of a	anaerobic and aerobic w		ical waste treatment plan letail, describe different te ods for waste analytics.		
Skills	control measurement	s. The students can recl		f plants. They can critical ature and date connected findings in the group.	-	
Personal Competence						
Social Competence	Students can particip	ate in subject-specific a	nd interdisciplinary discu	ssions, develop cooperate	ed solutions ar	nd defend their ov
	work results in front of others and promote the scientific development in front of colleagues. Furthermore, they can give					
Autonomy		idently tap knowledge fi		r test reports and transfo resentation, to assess the		
	steps on this basis. F		efine targets for new app	lication-or research-orien	-	
Workload in Hours	Independent Study Ti	me 110, Study Time in L	ecture 70			
Credit points	6					
Course achievement	Compulsory Bonus Yes None	Form Subject theoretical practical work	Description and			
Examination	Presentation					
Examination duration and	Elaboration and Prese	ntation (15-25 minutes i	n groups)			
scale						
Assignment for the	Civil Engineering: Spe	cialisation Structural En	gineering: Elective Compu	ilsory		
Following Curricula	Civil Engineering: Spe	cialisation Geotechnical	Engineering: Elective Cor	npulsory		
	• • •	-	eering: Elective Compulse	•		
			affic: Elective Compulsory	,		
	-	ering: Core Qualification				
		ment and Engineering, S	necialisation II Energy an	id Environmental Enginee	rına: Elective (	ompulsory
	International Manager					
	Joint European Master	in Environmental Studie		ity: Specialisation Energy:		

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

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

Courses							
Title			Тур		Hrs/wk	СР	
Computational Analysis of Concrete	Structures	(L0598)		Lecture		2	3
Computational Analysis of Concrete		(L0599)			on Section (large)	1	1
FE-Modeling of Concrete Structures	(L0600)			Project-/	problem-based Learning	2	2
Module Responsible	Prof. Günte	er Romba	ch				
Admission Requirements	None						
<b>Recommended Previous</b>	Basic know	ledge in :	structural analysis and	design of reinforced concrete	structures (beams, slab	s, shear walls	).
Knowledge	Lectures '	Concrete	Structures I und II'				
	Lectures '	Structural	Analysis I and II'				
	Lecture 'Co	oncrete St	tructures'				
Educational Objectives	After taking part successfully, students have reached the following learning 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							
Social Competence	The studer	nts can m	odel and design in tear	nwork a real concrete structure	e by means of a finite e	lement softwa	re package.
4							
Autonomy	The students can model and design a real concrete structure based on a finite element software package and discuss the proble			discuss the problem			
	and results with other students.						
Workload in Hours	Independe	nt Study <sup>-</sup>	Time 110, Study Time i	in Lecture 70			
Credit points	6						
Course achievement	Compulsory	Bonus	Form	Description			
	Yes	None	Excercises	Es ist ein Tragsystem	mit TEDDY zu modellier	ren	
	Yes	None	Attestation	Am Ende des Sems	ter ist ein Tragsystem	n mit dem R	echenprogramm z
				modellieren			
Examination	Oral exam						
Examination duration and	45 min						
scale							
Assignment for the	Civil Engin	eering: Sp	pecialisation Structural	Engineering: Elective Compuls	ory		
	-			cal Engineering: Elective Comp	•		
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory						
	-			Traffic: Elective Compulsory	,		

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

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

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

Courses				
Title	Тур		Hrs/wk	СР
Integrated Transportation Planning	(L1068) Project-/	problem-based Learning	4	6
Module Responsible	Prof. Carsten Gertz			
Admission Requirements	None			
<b>Recommended Previous</b>	some knowledge of transport planning, e.g. through taking the undergrad	luate class "Transport P	anning and Tr	affic Engineerin
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning	ng results		
Professional Competence				
Knowledge	Students are able to:			
	describe interdependencies between land-use/location choice and	transportation/mobility I	pehaviour	
	<ul> <li>explain and evaluate the social, ecological and economic effects of</li> </ul>			res.
	relate current issues in the area of integrated transport planning a	nd formulate an opinion	on them.	
Skills	Students are able to:			
	guantify important parameters, which influence travel demand or a	are influenced by it		
	<ul> <li>comprehensively examine a pre-defined or self-selected topic from</li> </ul>		es nersnective	and document t
	results in accordance with scientific conventions.		es perspective	
Personal Competence				
Social Competence	Students are able to:			
	<ul> <li>provide feedback on topical contents and their teaching.</li> </ul>			
	constructively handle feedback on their own work.			
	<ul> <li>produce results in group work and document these.</li> </ul>			
4				
Autonomy	Students are able to:			
	assess potential consequences of their future professional activitie	S		
	<ul> <li>independently plan working on a pre-defined project topic, acquire</li> </ul>	the necessary knowled	ge and use ap	propriate means
	its execution.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement				
Examination	Written elaboration			
Examination duration and	written assignment with presentation during the semester			
scale				
-	Civil Engineering: Specialisation Structural Engineering: Elective Compuls			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Comp	5		
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory	у		
	Civil Engineering: Specialisation Water and Traffic: Compulsory	bility Elective Comercia	0.00	
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mo Water and Environmental Engineering: Specialisation Water: Elective Con	,	ury	
	Water and Environmental Engineering: Specialisation Water: Elective Con Water and Environmental Engineering: Specialisation Environment: Electi			
	Water and Environmental Engineering: Specialisation Cities: Compulsory	i compaisory		

Course L1068: Integrated Tr	ansportation Planning
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Carsten Gertz, Dr. Philine Gaffron, Jacqueline Bianca Maaß
Language	DE
Cycle	WiSe
	The course will provide students with an understanding of interdependencies between land-use and transportation. Specific topics include a.o.:    interactions between transport and the environment and consequent limitations  characteristics of integrated planning  complex planning processes  interdependencies of location choice and mobility behaviour  transport and land-use policies  project on current issues in transportation studies
Literature	Kutter, Eckhard (2005) Entwicklung innovativer Verkehrsstrategien für die mobile Gesellschaft. Erich Schmidt Verlag. Berlin. Bracher, Tilman u. a. (Hrsg.) (68. Ergänzung 2013) Handbuch der kommunalen Verkehrsplanung. Herbert Wichmann Verlag. Berlin, Offenbach. (Loseblattsammlung mit kontinuierlichen Ergänzungen)

Module M0963: Steel	and Composite Structures			
Courses				
Title		Тур	Hrs/wk	СР
Steel and Composite Structures (LI	204)	Lecture	2	2
Steel and Composite Structures (LI	205)	Recitation Section (large)	2	2
Steel Bridges (L1097)		Lecture	2	2
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
<b>Recommended Previous</b>	Basics of steel construction (i.e. Steel Structures I and II, BUBC)	)		
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	After successful completition, students can			
	<ul> <li>describe the phenomenon of local buckling</li> </ul>			
	explain warping torsion			
	<ul> <li>illustrate the behaviour of composite structures</li> </ul>			
	<ul> <li>specify the principles in design of composite structures</li> </ul>			
	<ul> <li>sketch the contructions of steel and composite bridges</li> </ul>			
Skills	After successful participation students are able to			
	<ul> <li>check stiffened and unstiffened plated structures</li> </ul>			
	<ul> <li>recognize and verify warping tosion in strucures</li> </ul>			
	design composite structures			
	<ul> <li>design bridges and o perform the detailing</li> </ul>			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Compu	Ilsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elec	ctive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective C	Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Cor	npulsory		
	International Management and Engineering: Specialisation II. C	ivil Engineering: Elective Com	oulsory	

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

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

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

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

### Module M0969: Selected Topics in Civil Engineering

Courses				
Title	Тур		Hrs/wk	СР
Ergonomics (L0653)	Lecture		2	3
Construction robotics (L0708)	Project-/prol	blem-based Learning	3	3
Analysis of Offshore Structures (L18	867) Lecture		1	1
Excellence in International Project I	Delivery (L2387) Integrated L	ecture	2	2
Design of Prefabricated Concrete S	tructures (L0596) Lecture		1	1
Design of Prefabricated Concrete S	tructures (L0597) Recitation S	ection (large)	1	1
Forum I - Geotechnics and Construe	ction Management (L1634) Seminar		1	1
Forum II - Geotechnics and Constru	ction Management (L1635) Seminar		1	1
Geotechnical Engineering Design (I	L2447) Lecture		2	3
Timber Structures (L1151)	Seminar		2	2
Innovative Timber Construction (L2	666) Lecture		2	3
Glass Structures (L1152)	Lecture		2	2
Glass Structures (L1447)		ection (large)	1	1
-		blem-based Learning	2	2
Special topics of civil engineering 1			1	1
Special topics of civil engineering 2			2	2
Special topics of civil engineering 3			3	3
Structural Design (L2789)	Seminar		2	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
<b>Recommended Previous</b>	none			
Knowledge				
<b>Educational Objectives</b>	After taking part successfully, students have reached the following learning i	results		
Professional Competence				
Knowledge	<ul> <li>Students are able to find their way through selected special areas with</li> <li>Students are able to explain basic models and procedures in selected</li> </ul>			
	• Students are able to interrelate scientific and technical knowledge.			
Skills	• Students are able to apply basic methods in selected areas of civil and structural engineering.			
Personal Competence				
Social Competence				
Autonomy	<ul> <li>Students can chose independently, in which fields they want to deep courses.</li> </ul>	pen their knowledge	and skills thro	ough the election
Workload in Hours	Depends on choice of courses			
Credit points				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory	,		
Following Curricula				
i onowing curricula				
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory			

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

Course L0708: Construction	robotics
Тур	Project-/problem-based Learning
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Mündliche Prüfung
Examination duration and	15 min
scale	
Lecturer	Francisco Williams Riquer
Language	DE
Cycle	WiSe
Content	The students learn in the lecture the required knowledge in control systems to apply it to a specific project-based geotechnical problem. In a two-weeks time frame, students can test developed control strategies in the lab and present their results. At the end of the lecture, students will have an oral examination.
Literature	Ogata, Katsuhiko. Modern control engineering. Vol. 5. Upper Saddle River, NJ: Prentice hall, 2010. Ross, Timothy J. Fuzzy logic with engineering applications. John Wiley & Sons, 2005.

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

Course L2387: Excellence in International Project Delivery		
	Integrated Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Klausur	
Examination duration and	2 h	
scale		
Lecturer	Dr. Jens Huckfeldt	
Language	EN	
Cycle	SoSe	
Content	Simply and easy to avoid mistake in project delivery can deliver projects within budget and as per schedule.You	
	have to attend if you see yourself in project execution and potentially even abroad.	
Literature		

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

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

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

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

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

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

Course L2666: Innovative Tir	nber Construction			
Тур	Lecture			
Hrs/wk				
СР	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Examination Form	Schriftliche Ausarbeitung			
Examination duration and	45 Minuten			
scale				
Lecturer	Dr. Andreas Meisel			
Language				
Cycle	WiSe			
Content				
Literature	- Blass, J.: "Ingenieurholzbau"			
	- Schickhofer, G.: "BSPhandbuch: Holz-Massivbauweise in Brettsperrholz"			
	- Informationsdienst Holz: div. Merkblätter und Broschüren			
	- Wallner-Novak M.: Brettsperrholz Bemessung, Band 1 und 2			
	- Gerner M.: "Fachwerk: Entwicklung, Instandsetzung, Neubau"			
	- Meisel, A.: "Historische Dachwerke: Beurteilung, realitätsnahe statische Analyse und Instandsetzung"			
	- Kempe K.: "Dokumentation Holzschädlinge"			
	- Huckfeldt T.: "Hausfäule- und Bauholzpilze"			

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

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

Course L2725: Testing and non-destructive examination of concrete members				
Тур	Project-/problem-based Learning			
Hrs/wk	2			
СР	2			
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28			
Examination Form	Mündliche Prüfung			
Examination duration and	20 min			
scale				
Lecturer	Dr. Lukas Henze, Dr. Lukas Henze			
Language	DE			
Cycle	SoSe			
Content				
Literature				

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

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

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

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

Courses					
Title		Тур	Hrs/wk	СР	
Subsoil and Underground Engineering Law (L0395)		Lecture	2	3	
Service Contract and Procurement Law (L1906)		Lecture	2	3	
Module Responsible	Prof. Jürgen Grabe				
Admission Requirements	None				
<b>Recommended Previous</b>	Complete modules: Geotechnics I-III				
Knowledge					
Educational Objectives	After taking part successfully, students have	reached the following learning results			
Professional Competence					
Knowledge	Students will gain knowledge of				
	<ul> <li>the history of civil engineering law,</li> </ul>				
	<ul> <li>basics of foundation and civil engineer</li> </ul>	ing law.			
	<ul> <li>basics of foundation and civil engineering law,</li> <li>legal aspects of technical regulations in civil engineering (with case studies),</li> </ul>				
	<ul> <li>the civil engineering contract,</li> </ul>				
	<ul> <li>the liability of the designer and contractor in civil engineering,</li> </ul>				
	<ul> <li>the subsoil risk and the system risk,</li> </ul>				
	• the total debt in (civil) engineering law,				
	the (construction) conflict, dispute avoidance models and the construction process,				
	the systematics of construction contract law,				
	the BGB construction contract law,				
	responsibilities on the construction site,				
	remuneration and contract management,				
	liability for defects,				
	public procurement law.				
Skills	Students learn to apply legal aspects in plan	ning and construction in a legally balanced	l way.		
Personal Competence					
	Students can work in groups and support ead	h other in finding solutions.			
Autonomy	Students are able to assess their own strengt	hs and weaknesses and organize their tim	e and learning manage	ment based on thi	
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56			
Credit points	6				
Course achievement	None				
Examination	Oral exam				
Examination duration and	30 min				
scale					
Assignment for the	Civil Engineering: Specialisation Coastal Engi	neering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnica	I Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Structural Er	ngineering: Elective Compulsory			
	Civil Engineering: Specialisation Water and T	raffic: Elective Compulsory			

Тур	Lecture		
Hrs/wk	2		
CP	3		
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28		
Lecturer	Prof. Günther Schalk		
Language	DE		
Cycle	WiSe		
Content	History of Civil Engineering Law (from 1700 BC to 2000 AD)		
	• Basics of foundation and excarvation law / engineering law (the participants in the case law of geotechnical law case studies)		
	Legal aspects of technical regulations in civil engineering (with case studies)		
	• The civil engineering contract (including checklists for the special civil engineering contract design and execution)		
	• The liability of the planner and entrepreneur in civil engineering (practical examples, jurisprudence and law, inter alia,		
	ordinance on Combatants, liability for defects and traffic safety obligations, construction law and insurance questions)		
	• The ground / foundation risk and the systemic risk (also in the European context)		
	• The total debt in (low) building law (based on practice-oriented case constellations)		
	• The (construction) conflict, the dispute avoidance models and the construction process (practice-oriented presentation)		
Literature	Folienskript (in der Vorlesung erhältlich)		
	weitere Literatur:		
	Englert, Grauvogel und Maurer: Handbuch des Baugrund- und Tiefbaurechts. Werner-Verlag		

Course L1906: Service Contract and Procurement Law				
Тур	Lecture			
Hrs/wk	2			
СР	3			
Workload in Hours	pendent Study Time 62, Study Time in Lecture 28			
Lecturer	Günther Schalk, Prof. Jürgen Grabe			
Language	DE			
Cycle	WiSe			
Content				
Literature				

Courses					
Title		Тур	Hrs/wk	СР	
Chemistry of Drinking Water Treatment (L0311)		Lecture	2	1	
Chemistry of Drinking Water Treatment (L0312)		Recitation Section (large)	1	2	
Water Resource Management (L04)	)2)	Lecture	2	2	
Water Resource Management (L04)	03)	Recitation Section (small)	1	1	
Module Responsible	Prof. Mathias Ernst				
Admission Requirements	None				
<b>Recommended Previous</b>	Knowledge of water management and the	e key processes involved in water treatment.			
Knowledge					
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results			
<b>Professional Competence</b>					
Skills	water supply. They will understand relevant economic, environmental and social factors. Students will be able to explain a outline the organisational structures of water companies. They will be able to explain the available water treatment processes a the scope of their application.				
361/3	Students will be able to assess complex problems in drinking water production and establish solutions involving wat management and technical measures. They will be able to assess the evaluation methods that can be used for this. Students w be able to carry out chemical calculations for selected treatment processes and apply generally accepted technical rules a standards to these processes.				
Personal Competence					
Social Competence	Working in a diverse group of specialists,	, students will be able to develop and document	complex solutions	for the managem	
	and treatment of drinking water. They w	vill be able to take an appropriate professional	position, for examp	ole representing ι	
	interests. They will be able to develop join	nt solutions in teams of diverse experts and prese	nt these solutions t	to others.	
Autonomy	Students will be in a position to work on a	subject independently and present on this subje	ct.		
Workload in Hours	Independent Study Time 96, Study Time i	n Lecture 84			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	60 min (chemistry) + presentation				
scale					
Assignment for the	Civil Engineering: Specialisation Structura	l Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechr	nical Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Water an	d Traffic: Compulsory			
	Civil Engineering: Specialisation Coastal E	Engineering: Elective Compulsory			
	International Management and Engineerir	ng: Specialisation II. Energy and Environmental Er	gineering: Elective	Compulsory	
	Process Engineering: Specialisation Enviro	onmental Process Engineering: Elective Compulso	ry		
	Process Engineering: Specialisation Proce	ss Engineering: Elective Compulsory			
	Water and Environmental Engineering: Sp	pecialisation Water: Compulsory			
	Water and Environmental Engineering: Sp	pecialisation Environment: Elective Compulsory			

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

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

Course L0402: Water Resour	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	<ul> <li>The lecture provides comprehensive knowledge on interaction of water ressource management and drinking water supply. Content overview: <ul> <li>Current situation of global water resources</li> <li>User and Stakeholder conflicts</li> <li>Wasserressourcenmanagement in urbane Gebieten</li> <li>Rechtliche Aspekte, Organisationsformen Trinkwasserversorgungsunternehmen.</li> <li>Ökobilanzierung, Benchmarking in der Wasserversorgung</li> </ul> </li> </ul>		
Literature	<ul> <li>Aktuelle UN World Water Development Reports</li> <li>Branchenbild der deutschen Wasserwirtschaft, VKU (2011)</li> <li>Aktuelle Artikel wissenschaftlicher Zeitschriften</li> <li>Ppt der Vorlesung</li> </ul>		

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

Courses				
Title		Тур	Hrs/wk	СР
Adaptation to climate change in hyc	draulic engineering (L2291)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Peter Fröhle			
Admission Requirements				
Recommended Previous				
Knowledge	Hydrology, Hydraulic Engineering			
	Hydromechanic, Hydraulics     Sundamentals of Coastal Englishering, Coastal I	and Fland Ducks shine		
	<ul> <li>Fundamentals of Coastal Engineering, Coastal- a</li> <li>Hydrological Systems</li> </ul>	and Flood Protection		
Educational Objectives	After taking part successfully, students have reached t	he following learning results		
<b>Professional Competence</b>				
Knowledge	Climate protection and climate adaptation			
	<ul> <li>Climate protection and climate adaptation</li> <li>Insights into climate change and its regional cha</li> </ul>	vractoristics fundamentals climate mode	lling / climato	models
	<ul> <li>Insights into climate change and its regional cha</li> <li>Impacts of climate change on the components o</li> </ul>		ining / chimate	models
	<ul> <li>Fundamentals of analysis of climate data</li> </ul>			
	<ul> <li>Consequences of the impact of the climate chan</li> </ul>	nge		
	<ul> <li>Measures for climate adaptation</li> </ul>	.ge		
	<ul> <li>Assessment, prioritization and communication or</li> </ul>	f adaptation measures		
	<ul> <li>Fundamentals of the analysis of hydrometeorology</li> </ul>			
Skills	<ul> <li>Critical thinking: analysis of processes and relati</li> </ul>	ions, assessment of needs for action		
	Creative thinking: development of adaptation st			
	<ul> <li>Practical thinking: inclusion of restrictions, application</li> </ul>	•	nods, numeric	al models, plann
	methods			
	<ul> <li>Consideration of complex tasks</li> </ul>			
Personal Competence				
Social Competence	<ul> <li>Working in heterogenous groups</li> </ul>			
	Working with different scientific / non-scientific of the scientific / non-scientific of the scientific of the scientific of the scientific of the scientific of the science of the s	disciplines		
	Self reflection	uiscipinies		
Autonomy	<ul> <li>Application oriented use of knowledge and skills</li> </ul>			
	<ul> <li>Application offented use of knowledge and skins</li> <li>Autonomous work on complex tasks</li> </ul>			
	· · · · · · · · · · · · · · · · · · ·			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	5		
Credit points				
Course achievement				
	Preparation of a written report and a presentation of a	complex task.		
scale				
Assignment for the				
	Civil Engineering: Specialisation Geotechnical Engineer	•		
-				
-	Civil Engineering: Specialisation Structural Engineering			
	Civil Engineering: Specialisation Water and Traffic: Elec	ctive Compulsory		
		ctive Compulsory Cities: Elective Compulsory		

ourse L2291: Adaptation to climate change in hydraulic engineering		
	Project-/problem-based Learning	
Hrs/wk	4	
CP	6	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Prof. Peter Fröhle	
Language	DE	
Cycle	WiSe	
Content	<ul> <li>Climate protection and climate adaptation</li> <li>Findings on climate change and its regional characteristics: fundamentals of climate change, climate modelling / climate models</li> <li>Impacts of climate change on the components of the regional hydrological cycle(climate science view)</li> <li>Fundamentals of the analysis of climate data</li> <li>Concequences of the impacts of climate change (ingenieering science view)</li> <li>Measures for climate change adaptation</li> <li>Assessment, prioritization and communication of measures</li> <li>Fundamentals of analysis of hydrometeorological and hydrological data</li> </ul>	
Literature	Bereitgestellte eLearning Plattform	

Module M1716: Subsi	urface Processes			
Courses				
<b>Fitle</b>		Тур	Hrs/wk	СР
Modeling of Subsurface Processes (	L2731)	Recitation Section (small)	3	3
Subsurface Solute Transport (L272)		Lecture	2	2
Subsurface Solute Transport (L272)		Recitation Section (large)	1	1
Module Responsible				
Admission Requirements	None			
Recommended Previous	Basic Mathematics, Hydrology			
Knowledge				
Educational Objectives	After taking part successfully, students have r	eached the following learning results		
Professional Competence				
Knowledge		its will understand the mechanisms controlling		
		e equations that govern the fate and transport of	of solutes in poro	us media. Analyti
	numerical and experimental tools and techniques will be used in this module.			
Skills	Skills In addition to the physical insights, the students will be exposed to analytical, experimental and numerical tools a		ols and technique	
		llent opportunity to improve their skills on multi		
	future career.			
Personal Competence				
Social Competence	Teamwork & problem solving			
Autonomy	The students will be involved in writing ind	lividual reports and presentation. This will co	ntribute to the s	students' ability a
	willingness to work independently and respon	sibly.		
Workload in Hours	Independent Study Time 96, Study Time in Le	cture 84		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	Report and Presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Eng	gineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical	Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engin	eering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Tra	affic: Elective Compulsory		
	Process Engineering: Specialisation Environme	ental Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process Er	ngineering: Elective Compulsory		
	Water and Environmental Engineering: Specia	lisation Water: Compulsory		
	Water and Environmental Engineering: Specia	lisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Specia			

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

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

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

Courses				
			Line (mile	
<b>Title</b> Scientific Working in Computationa	Engineering (12764)	<b>Typ</b> Project-/problem-based Learning	Hrs/wk 4	<b>CP</b> 6
Module Responsible				
Admission Requirements				
-		g interest in topics related to computing in civil engine	erina.	
Knowledge			5	
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Skills Personal Competence Social Competence	thinking, being able to accurately plan, ir will be conducted throughout the semeste this course, a scientific paper will be deve	h each other, the students will also learn to understand mplement and analyze scientific projects, such as pro r, which will contribute to the grade. Since scientific wi cloped based, which is a prerequisite for the final exan nis course. Project meetings in small groups, present vities.	ospective mast riting is of part nination. The J	ter theses. A proj ticular importance paper will be writ
Autonomy				
	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	10 pages of work with 15-minute oral pres	entation		
scale				
-	Civil Engineering: Specialisation Water and			
Following Curricula	Civil Engineering: Specialisation Geotechn			
	Civil Engineering: Specialisation Coastal En			
	Civil Engineering: Specialisation Structural	Engineering: Elective Compulsory		

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

Courses				
Title		Тур	Hrs/wk	СР
Sustainable Nature-based Coastal	Protection in a Changing Climate (SeaPiaC) (L2926)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge	Hydraulic Engineering			
	<ul> <li>Hydromechanics, Hydraulics</li> <li>Fundamentals of Coastal Engineering, Coastal- a</li> </ul>	nd Flood Protection		
		nd hood Protection		
Educational Objectives	After taking part successfully, students have reached t	ne following learning results		
Professional Competence				
Knowledge	- Climate and Climate Change			
	Climate and Climate Change     Constal Impacts of Climate Change on Wind Res	ime and Water Cycle		
	<ul> <li>General Impacts of Climate Change on Wind Reg</li> <li>Consequences of Climate Change for Coastal Pro</li> </ul>			
	<ul> <li>Coastal Protection in Taiwan and Germany</li> </ul>			
	<ul> <li>Fundamentals of Climate Adaptation</li> </ul>			
	Nature-based Solutions (NBS) for Coastal Protect	ion		
Skills	Critical thinking: analysis of processes and relations, assessment of needs for action			
	<ul> <li>Creative thinking: development of adaptation still</li> </ul>			
	<ul> <li>Practical thinking: inclusion of restrictions, apprendiction</li> </ul>		ods, numerica	al models, plannii
	methods			
	Consideration of complex tasks			
Personal Competence				
Social Competence				
Social Competence	Working in heterogenous groups			
	<ul> <li>Working in international groups</li> </ul>			
	<ul> <li>Working with different scientific / non-scientific of</li> </ul>	isciplines		
	Self reflection			
Autonomy				
	<ul> <li>Application oriented use of knowledge and skills</li> </ul>			
	<ul> <li>Autonomous work on complex tasks</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Preparation of a written report on a complex task with	a presentation and subsequent discussion	on. The work o	on the complex ta
scale	happens in the course of the lecture.			
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: E	lective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineer	ing: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering	Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elec	tive Compulsory		
	Water and Environmental Engineering: Specialisation C	ities: Elective Compulsory		
	Water and Environmental Engineering: Specialisation E	nvironment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation V	/ater: Elective Compulsory		

Course L2926: Sustainable N	lature-based Coastal Protection in a Changing Climate (SeaPiaC)
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Peter Fröhle
Language	EN
Cycle	WiSe
Content	<ul> <li>Climate and Climate Change</li> <li>General Impacts of Climate Change on Wind Regime and Water Cycle</li> <li>Consequences of Climate Change for Coastal Processes</li> <li>Coastal Protection in Taiwan and Germany</li> <li>Fundamentals of Climate Adaptation</li> <li>Nature-Based Solutions (NBS) for Coastal Protection</li> </ul>
Literature	Materials provided on eLearning Platform (HOOU Platform)

Courses						
Title				Тур	Hrs/wk	СР
Finite element modeling of structur	res (L3046)			Lecture	2	3
Finite element modeling of structur				Recitation Section (small)	2	3
Module Responsible	Prof. Bastian Oesterle					
Admission Requirements	None					
Recommended Previous Knowledge	<ul> <li>Finite Element Me</li> <li>Thin-walled struct</li> </ul>					
	• Thin-walled scruce	ules				
Educational Objectives	After taking part success	fully, students have r	eached the followin	g learning results		
Professional Competence						
Knowledge	After successful complet	ion of this module, stu	idents can express	the basic aspects of modelli	ng of structures v	vith finite element
Skills	After successful comple structures using appropr			e able to model structures	with finite elem	ents and to analy
Personal Competence						
Social Competence	Students can					
	<ul><li> defend their own</li><li> promote the scier</li></ul>	ect-specific and intero work results in front o tific development of o can give and accept	f others colleagues			
Autonomy	-	÷		en and other sources and a area of finite element mod		
Workload in Hours	Independent Study Time	124, Study Time in L	ecture 56			
Credit points	6					
Course achievement	Yes 20 % S	orm ubject theoretical ractical work	•	iner Finite-Elemente-Modelli E-Software inklusive Doku		
Examination	Written exam					
Examination duration and scale	60 min					
Assignment for the	Civil Engineering: Specia	lisation Coastal Engin	eering: Elective Cor	npulsory		
Following Curricula	Civil Engineering: Specia Civil Engineering: Specia		• •			
			-	hnology: Elective Compulso		

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

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

Courses				
Title		Тур	Hrs/wk	СР
Modern discretization methods in st	tructural mechanics (L3043)	Lecture	2	3
Modern discretization methods in s		Recitation Section (small)	2	3
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous Knowledge	<ul><li>Finite Element Methods</li><li>Flächentragwerke</li></ul>			
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, students can express the basic aspects of modern discretization methods in structura mechanics.			
Skills	After successful completion of this module, the students will be able to use and further improve modern discretization methods for problems in structural mechanics.			
Personal Competence				
Social Competence	Students can			
	<ul> <li>participate in subject-specific and ir</li> </ul>	nterdisciplinary discussions,		
	• defend their own work results in fro	nt of others		
	<ul> <li>promote the scientific development</li> </ul>	of colleagues		
	<ul> <li>Furthermore, they can give and acc</li> </ul>	ept professional constructive criticism		
Autonomy	• •	e subject area from given and other sources and a cess for problems in the area of modern discretizal		oblems. Furthermo
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
-	Civil Engineering: Specialisation Coastal En			
Following Curricula	Civil Engineering: Specialisation Geotechn			
	Civil Engineering: Specialisation Structural			

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

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

Module M1845: Thin-	walled structures			
Courses				
Title		Тур	Hrs/wk	СР
Thin-walled structures (L1199)		Lecture	2	3
Thin-walled structures (L3045)		Recitation Section (large)	2	3
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge	Structural Analysis I			
	Structural Analysis II			
	Finite Element Methods			
Educational Objectives	After taking part successfully, students have reached the f	ollowing learning results		
<b>Professional Competence</b>				
Knowledge	After successful completion of this module, the students	can express the basic aspects of	the load-carryin	g behaviour of thin
	walled structures.			
Skills	After successful completion of this module, the students will be able to predict load-carrying behaviour of thin-walled structures			
	using appropriate analytical and coputational methods.			
Personal Competence				
Social Competence	Students can			
	<ul> <li>participate in subject-specific and interdisciplinary d</li> </ul>	iscussions,		
	<ul> <li>defend their own work results in front of others</li> </ul>			
	<ul> <li>promote the scientific development of colleagues</li> </ul>			
	<ul> <li>Furthermore, they can give and accept professional</li> </ul>	constructive criticism		
Autonomv	Students are able to gain knowledge of the subject area fr	om given and other sources and an	ply it to new pro	blems. Furthermore
	they are able to structure the solution process for problem	•		
		<u> </u>		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Elect	ive Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Ele	ective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elect	ive Compulsory		
	Civil Engineering: Specialisation Geotechnical Engineering:	Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Ele	ective Compulsory		
	Theoretical Mechanical Engineering: Specialisation Simulat	ion Technology: Elective Compulso	ry	

Course L1199: Thin-walled st	tructures			
Тур	Lecture			
Hrs/wk	2			
СР	3			
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28			
Lecturer	Prof. Bastian Oesterle			
Language	DE			
Cycle	SoSe			
Content	Plates loaded in-plane			
	Governing equations (equilibrium, kinematics, constitutive law)			
	Differential equation			
	Airy stress function			
	Plane stress / plane strain			
	Structural behaviour of plates loaded in-plane			
	<ul> <li>finite elements for plates loaded in-plane, modelling apsects, interpretation and critical assessment of results</li> </ul>			
	Plates in bending			
	Governing equations (equilibrium, kinematics, constitutive law)			
	Differential equation			
	Navier solution / Fourier series expansion			
	Approximation procedures			
	Circular and rectangular plates			
	Structural behaviour of plates in bending			
	<ul> <li>finite elements for plates in bending, modelling apsects, interpretation and critical assessment of results</li> </ul>			
	Shells			
	Phenomenona of the structural behaviour of shells			
	Membrane and bending theory			
	• Equilibrium equations of shells of revolution			
	<ul> <li>Stress resultants and deformations of the spherical shell, the half spherical shell, and the cylindrical shell</li> </ul>			
	finite elements for shells			
	Stability problems (overview)			
	Plate buckling			
	Shell buckling			
	• Shell buckling			
Literature				
	Vorlesungsmanuskript			
	Basar, Y.: Krätzig, W.B. (1985): Mechanik der Flächentragwerke. Vieweg-Verlag, Braunschweig, Wiesbaden			
	• Girkmann, K. (1963): Flächentragwerke, Springer Verlag, Wien, 1963, unveränderter Nachdruck 1986			
	• Zienkiewicz, O.C. (1977): The Finite Element Method in Enginieering Science. McGraw-Hill, London			

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

#### **Specialization Geotechnical Engineering**

#### Module M0699: Geotechnics III Courses Title Тур Hrs/wk СР Numerical Methods in Geotechnics (L0375) Lecture 3 3 2 2 Advanced Foundation Engineering (L0497) Lecture Advanced Foundation Engineering (L0498) Recitation Section (large) 1 1 Module Responsible Prof. Jürgen Grabe Admission Requirements None **Recommended Previous** Knowledge Educational Objectives After taking part successfully, students have reached the following learning results **Professional Competence** Knowledge Skills Personal Competence Social Competence Autonomy Workload in Hours Independent Study Time 96, Study Time in Lecture 84 Credit points 6 Course achievement None Examination Written exam Examination duration and 120 min scale Assignment for the Civil Engineering: Specialisation Structural Engineering: Compulsory Following Curricula Civil Engineering: Specialisation Geotechnical Engineering: Compulsory Civil Engineering: Specialisation Coastal Engineering: Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory

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

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

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

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

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

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

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

Courses				
			11	
Title Basics of Coastal Engineering (L08)	17)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 4
Basics of Coastal Engineering (L08) Basics of Coastal Engineering (L14)		Project-/problem-based Learning	1	2
Module Responsible				
Admission Requirements				
	Basics of hydraulic engineering, hydrology and hydro	mechanics		
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	The students are able to define and explain the basic	concepts of coastal engineering and port e	ngineering. T	hey are able to ap
	the concepts to selected practical problems of coast	al engineering. Students can define and de	termine the b	pasics for design a
	dimensioning of coastal engineering constructions.			
Skille	The students are capable to apply basic design appro	aschas to solosted and are defined design t	ocks in coasta	Longingering
JKIIIS	The students are capable to apply basic design apple	aches to selected and pre-defined design ta		r engineering.
Personal Competence				
Social Competence	The students are able to deploy their gained knowle	dge in applied problems such as the desig	n of coastal p	protection structur
	Additionaly, they will be able to work in team with en	gineers of other disciplines, for instance des	signing of coa	stal breakwaters.
Autonomy	The students will be able to independently extend the	eir knowledge and applyit to new problems		
hatohomy	The students will be usie to independently extend the	si knowledge und applyte to new problems.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 2 hours. The examination	camination includes tasks with respect to	the general u	understanding of t
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural Engineering	ig: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine	• • •		
	Civil Engineering: Specialisation Coastal Engineering:			
	International Management and Engineering: Specialis	ation II. Civil Engineering: Elective Compuls	ory	

Course L0807: Basics of Coas	ourse L0807: Basics of Coastal Engineering		
Тур	Lecture		
Hrs/wk	3		
СР	4		
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42		
Lecturer	Prof. Peter Fröhle		
Language	DE		
Cycle	WiSe		
Content	<ul> <li>Basics of planning and design <ul> <li>Water levels</li> <li>Currents</li> <li>Waves</li> <li>Ice</li> </ul> </li> <li>Planning and Design in Coastal Engineering <ul> <li>Functional and constructional design</li> <li>Determination of design parameters</li> <li>Design-approaches <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 Coas	urse L1413: Basics of Coastal Engineering		
Тур	Project-/problem-based Learning		
Hrs/wk	1		
СР	2		
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14		
Lecturer	Prof. Peter Fröhle		
Language	DE		
Cycle	WiSe		
Content	See interlocking course		
Literature	See interlocking course		

Module M0964: Unde	ground Constructions			
Hodale Hoso Honae	ground constructions			
Courses				
Title		Тур	Hrs/wk	СР
Applied Tunnel Constructions (L240	7)	Lecture	2	3
Introduction to tunnel construction	(L0707)	Lecture	1	2
Introduction to tunnel construction	(L1811)	Recitation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>	Modules from Bachelor studies Civil and e	nvironmental engineering:		
Knowledge				
	Geotechnics I-II			
	Steel Structures I-II			
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
Knowledge	Knowledge of different tunnel constructio	n types as well as special methods and techniqu	ues of subsoil const	ruction. The studer
-		d engineering as well as constructions knowledge		
	students get all the neccessary knowled	ge to design singular construction elements for	sheet pile walls ar	nd they know how
	choose the right construction elements de	epending on the influencing conditions.		
Skills	Basic knowledge of tunnel design as wel	II as practical skills in structural tunnel analysis	. Furthermore, the	students are able
	dimension sheet pile wall construction regarding all construction elements, to choose the suitable construction		uction elements wi	
	respect to the influencing conditions, to c	design all kinds of sheet pile walls (wave sheet p	ile walls and comb	ined sheet pile wal
	and to dimension all construction element	ts and connections.		
Personal Competence				
Social Competence	Capacity for teamwork concerning project	management and design of tunnels.		
Autonomy	Promotion of independent and creative we	ork flow in the framework of a design exercise.		
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 minutes			
scale				
Assignment for the	Civil Engineering: Specialisation Structura	I Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechn	nical Engineering: Compulsory		
	Civil Engineering: Specialisation Coastal E	ngineering: Compulsory		
	Civil Engineering: Specialisation Water and	d Traffic: Elective Compulsory		
	International Management and Engineerin	a Creciplication II. Civil Engineering, Elective Co		

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

Course L0707: Introduction t	to tunnel construction
Тур	Lecture
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Dr. 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> </ul>
Literature	Literature and sources     Vorlesung/Übung s. www.tu-harburg.de/gbt

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

Module M0511: Elect	rical Energy from Solar Radiat	tion and Wind Power		
Courses				
Title		Тур	Hrs/wk	СР
Sustainability Management (L0007	)	Lecture	2	1
Hydro Power Use (L0013)		Lecture	1	1
Wind Turbine Plants (L0011)		Lecture	2	3
Wind Energy Use - Focus Offshore	L0012)	Lecture	1	1
Module Responsible	Dr. Isabel Höfer			
Admission Requirements	None			
<b>Recommended Previous</b>	Module: Technical Thermodynamics I,			
Knowledge	Module: Technical Thermodynamics II,			
	Module. Technical mernodynamics II,			
	Module: Fundamentals of Fluid Mechanics			
Educational Objectives	After taking part successfully, students hav	ve reached the following learning results		
Professional Competence				
•	By ending this module students can expla	ain in detail knowledge of wind turbines wit	h a particular focus of	f wind energy use
	offshore conditions and can critical comme	ent these aspects in consideration of current	developments. Furthe	rmore, they are ab
	to describe fundamentally the use of water	r power to generate electricity. The students	reproduce and explain	the basic procedu
	in the implementation of renewable energy	y projects in countries outside Europe.		
		pics within the seminar of the module, stud		derstanding and t
	application of the theoretical background a	and are thus able to transfer what they have I	earned in practice.	
Skills	Students are able to apply the acquired	theoretical foundations on exemplary water	or wind power syster	ms and evaluate a
	assess technically the resulting relationshi	ips in the context of dimensioning and opera	ation of these energy s	systems. They can
	compare critically the special procedure fo	r the implementation of renewable energy p	rojects in countries out	side Europe with t
	in principle applied approach in Europe and	d can apply this procedure on exemplary the	pretical projects.	
Personal Competence				
Social Competence	Students can discuss scientific tasks subje	t-specificly and multidisciplinary within a sen	ninar.	
<b>A 1 </b>				
Autonomy		es in the context of the emphasis of the lea	cture material to clear	the contents of the
	lecture and to acquire the particular knowle	edge about the subject area.		
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	2.5 hours written exam + written elaborati	on (incl. presentation) in sustainability manag	gement	
scale				
Assignment for the	Civil Engineering: Specialisation Structural	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechni	cal Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal En	igineering: Elective Compulsory		
		g: Specialisation II. Energy and Environmenta	• •	Compulsory
		g: Specialisation II. Renewable Energy: Electiv		
		ction: Specialisation Product Development: E		
		ction: Specialisation Production: Elective Con		
		ction: Specialisation Materials: Elective Comp	oulsory	
	Renewable Energies: Core Qualification: Co			
	5 5 1	alisation Energy Systems: Elective Compulsor	5	
		nmental Process Engineering: Elective Compu	ilsory	
	Water and Environmental Engineering: Spe			
	Water and Environmental Engineering: Spe	ecialisation Cities: Elective Compulsory		

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

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Digital Building (L1908)		Lecture	2	2
Lean Construction (L1910)		Lecture	2	2
System Dynamics (L1909)		Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Tim	e in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coasta	I Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geoted	chnical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Structu	ural Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water	and Traffic Floctive Compulsory		

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

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

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

Courses				
		Torr	11	60
Fitle	Multishees Flau in Densus Media (12720)	Typ	Hrs/wk 2	<b>CP</b> 2
	Multiphase Flow in Porous Media (L2738) Porous Media (L2736)	Recitation Section (small) Lecture	2	2
Fundamentals of Multiphase Flow in Porous Media (L2736) Fundamentals of Multiphase Flow in Porous Media (L2737)		Recitation Section (large)	2	2
Module Responsible				
Admission Requirements				
<b>Recommended Previous</b>				
Knowledge				
Educational Objectives	After taking part successfully, students have reache	ed the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
, Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture	84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engin	eering: Elective Compulsory		
	Civil Engineering: Specialisation Geotechnical Engin	eering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory		
	Environmental Engineering: Specialisation Water: E	lective Compulsory		
	Environmental Engineering: Specialisation Water: E	lective Compulsory		
	Water and Environmental Engineering: Specialisation	on Cities: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	on Cities: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	on Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	on Environment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	on Water: Elective Compulsory		
	Water and Environmental Engineering: Specialisation	on Water: Elective Compulsory		

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

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

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

## Module M0593: Building Materials and Building Preservation

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

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

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

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

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

Courses					
Title		Тур	Hrs/wk	СР	
Design of Prestressed Structures a	nd Concreet Bridges (L0603)	Lecture	3	4	
Design of Prestressed Structures a	nd Concreet Bridges (L0604)	Recitation Section (large)	2	2	
Module Responsible	Prof. Günter Rombach				
Admission Requirements	None				
<b>Recommended Previous</b>	Detailed knowledge on the design of conc	rete structures.			
Knowledge	Modules: Reinforced Concrete Structures I+II, Structural Analysis I+II, Mechanics I+II, Concrete Structures				
Educational Objectives	After taking part successfully, students have reached the following learning results				
Professional Competence					
Knowledge	The students know the main bridge types, their applications and the various loads. They can explain the basic design method				
	They can explain the design of a prestressed bridge.				
Skills	The students are able to design reinforced or prestressed concrete bridges.				
Personal Competence					
•	The students can design in teamwork a real concrete bridge.				
Autonomy	The students are able to design a prestressed concrete bridge and discuss the problems and results with other students.				
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70			
Credit points					
Course achievement	None				
Examination	Written exam				
Examination duration and	180 minutes				
scale					
Assignment for the	Civil Engineering: Specialisation Structura	l Engineering: Compulsory			
-	Civil Engineering: Specialisation Geotechn				
	Civil Engineering: Specialisation Coastal E	ngineering: Elective Compulsory			
	International Management and Engineerin	g: Specialisation II. Civil Engineering: Elective Com	nulcon		

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

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

Courses						
				-	11	<b>C</b> D
<b>Title</b>				Тур	Hrs/wk	СР
Soil Mechanics - Selected Topics (L Soil Dynamics (L0452)	J374)			Lecture Lecture	2 3	2 2
Experimental Researches in Geotec	hnics (L0706)			Practical Course	1	2
Module Responsible						
Admission Requirements						
<b>Recommended Previous</b>	modules: Mathemati	cs I-III, Mechanics I-II, Ge	otechnics I			
Knowledge	courses: Soil laborat	ory course, (Applied stru	ctural dynamics)			
Educational Objectives	After taking part suc	cessfully, students have	reached the followi	ing learning results		
Professional Competence						
Knowledge	After the successful	completion of the modul	e the students shou	uld be able to:		
		to apply the basic equat		namic excitation and to de	stact the relevant par	amotors
				nine soil dynamic characte		
						e them,
	<ul> <li>to design machine foundations to dynamic load,</li> <li>to measure shacks to perform vibration forecast.</li> </ul>					
	<ul> <li>to measure shocks to perform vibration forecast,</li> <li>to evaluate shocks in term to their effect on people and buildings.</li> </ul>					
	<ul> <li>to evaluate shocks in term to their effect on people and buildings,</li> <li>to evaluate possibilities of isolation,</li> </ul>					
	<ul> <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> </ul>					
	<ul> <li>to understand mechanisms that cause earthquakes and evaluate earthquake in term of their magnitude and intensity,</li> <li>to know methods to determine axial pile capacity, integrity and the dynamic bedding modulus,</li> </ul>					
	<ul> <li>to know the mechanisms that lead to a deformation accumulation due to cyclic loading and to estimate these deformations</li> </ul>					
	<ul> <li>to know the mechanisms that lead to a deformation accumulation due to cyclic loading and to estimate these deformations mathematically,</li> </ul>					
	<ul> <li>to distinguish the area of application of the method of elastodynamics and plastodynamics,</li> </ul>					
	- to distinguish the area of application of the method of clastodynamics and plastodynamics,					
	• to detect the undrained shear strength as a function of a number of state variables,					
	<ul> <li>to detect the undrafted 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</li> </ul>					
	calculations,					
	<ul> <li>to consider the impact of the partly saturated of a seepage and shear strength.</li> </ul>					
Skills						
Personal Competence						
Social Competence						
Autonomy	Juden en deut Ch. d. 7		ture 0.4			
		ime 96, Study Time in L	ecture 84			
Credit points Course achievement	Compulsory Bonus	Form	Description			
course achievement	Yes 15 %	Subject theoretical	and			
		practical work				
Examination						
Examination duration and	150 min					
scale						
Assignment for the	Civil Engineering: Sn	ecialisation Structural E	naineerina: Elective	e Compulsory		
Following Curricula		ecialisation Geotechnica				
				P		

Course L0374: Soil Mechanic	Course L0374: Soil Mechanics - Selected Topics		
Тур	Lecture		
Hrs/wk	2		
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Dr. Hans Mathäus Stanford		
Language	DE		
Cycle	SoSe		
Content	selected topis:		
	- continuum mechanis		
	- constitutive modelling		
	- time and rate dependend material behavior of soils		
	- cyclic loading		
	- undrained conditions		
Literature	Kolymbas D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. Springer Verlag		

Course L0452: Soil Dynamics	i			
Тур	Lecture			
Hrs/wk	3			
СР	2			
Workload in Hours	Independent Study Time 18, Study Time in Lecture 42			
Lecturer	exander Chmelnizkij			
Language	DE			
Cycle	SoSe			
Content	• mass-spring-damper systems,			
	• wave propagation in soils,			
	dynamic soil parameters,			
	Determination of dynamic soil parameters,			
	• machine foundations,			
	<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: Experimental	Researches in Geotechnics
Тур	Practical Course
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Dr. Marius Milatz
Language	DE
Cycle	SoSe
Content	The students are supposed to:
	<ul> <li>become acquainted with geotechnical model tests, field tests and laboratory tests as well as corresponding measurement techniques. These compromise amongst others inclinometer measurements and geophone measurements as well as high-grade laboratory tests on the stress-strain relationship of soil specimens, e. g. triaxial tests, simple shear tests and resonant column tests.</li> <li>gain insight into current soil mechanical research.</li> <li>plan, coordinate, perform and evaluate soil mechanical tests in a team.</li> <li>discuss, reflect, review and present the obtained results in a group.</li> </ul> An important learning target is the introduction to scientific work for students who plan a scientific career, and for those who will work in practice with the responsibility to order corresponding tests and evaluate the results. The practical laboratory work is based on annualy changing problems, which are however related to the experience and results of the preceding year's course group.
Literature	- Grabe, J. (2004): Bodenmechanik und Grundbau, Band 3 der Veröffentlichungsreihe des Instituts für Geotechnik und Baubetrieb, Technische Universität Hamburg-Harburg.
	- Kolymbas, D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. 2., korrigierte und ergänzte Auflage, Springer Verlag.
	<ul> <li>Normen zu geotechnischen Versuchsgeräten und Versuchsverfahren:</li> <li>DIN 18135:2012-04: Baugrund, Untersuchung von Bodenproben -</li> <li>Eindimensionaler Kompressionsversuch, Deutsches Institut für</li> <li>Normung, e. V.</li> </ul>
	- DIN 18137-2:2011-04: Baugrund, Untersuchung von Bodenproben - Bestimmung der Scherfestigkeit - Teil 2: Triaxialversuch, Deutsches Institut für Normung e. V.

Module M0807: Boun	dary Element Methods				
Courses					
Title			Тур	Hrs/wk	СР
Boundary Element Methods (L0523	)		Lecture	2	3
Boundary Element Methods (L0524			Recitation Section (large)	2	3
Module Responsible	Prof. Otto von Estorff				
Admission Requirements	None				
<b>Recommended Previous</b>	Mechanics I (Statics, Mechanics o	of Materials) and Mechanics II	(Hydrostatics, Kinematics, Dyn	amics)	
Knowledge	Mathematics I, II, III (in particular	differential equations)			
Educational Objectives	After taking part successfully, stu	idents have reached the follo	wing loarning recults		
	After taking part successiony, sto		wing learning results		
Professional Competence	-	L. L. S. J. J. S. S. S. P. S. D. S.	to develop a second second second second		
Knowledge	The students possess an in-dept			nent method and	are able to give a
	overview of the theoretical and n	nethodical basis of the metho	d.		
Skills	The students are capable to	handle engineering probler	ms by formulating suitable I	oundary elemer	nts, assembling t
	corresponding system matrices,	and solving the resulting syst	em of equations.		
		5			
Personal Competence					
	Students can work in small group	e en enecífic probleme to arri	ve at joint colutions		
Social Competence	Students can work in small groups on specific problems to arrive at joint solutions.				
Autonomy	The students are able to independently solve challenging computational problems and develop own boundary element routines				
	Problems can be identified and the results are critically scrutinized.				
		· · · · · · · · <b>,</b> · · ·			
Workload in Hours	Independent Study Time 124, Stu	udy Time in Lecture 56			
Credit points	6				
Course achievement	Compulsory Bonus Form	Description			
	No 20 % Midterm				
Examination	Written exam				
Examination duration and	90 min				
scale					
Assignment for the	Civil Engineering: Specialisation S	Structural Engineering: Electiv	ve Compulsory		
Following Curricula	Civil Engineering: Specialisation	Geotechnical Engineering: Ele	ective Compulsory		
	Civil Engineering: Specialisation (	Coastal Engineering: Elective	Compulsory		
	Energy Systems: Core Qualificati	on: Elective Compulsory			
	Mechanical Engineering and Man	agement: Specialisation Prod	uct Development and Production	on: Elective Comp	ulsory
	Mechatronics: Specialisation Syst	•			-
	Product Development, Materials	5	,		
	Technomathematics: Specialisati				
	Theoretical Mechanical Engineeri	ng: Specialisation Simulation	Technology: Elective Compulse	bry	

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

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

Courses					
Title		Тур	Hrs/wk	СР	
Groundwater Modeling using Modflow (L0543)		Lecture	1 2	1 2	
Groundwater Modeling using Modfl Modeling of Water Supply and Sew		Recitation Section (small) Project-/problem-based Learning	2	2	
Module Responsible		·····		-	
Admission Requirements	None				
Recommended Previous	Groundwater				
Knowledge	a groundwater budraulies and transport of substa				
	groundwater hydraulics and transport of substances				
	Pipe Systems				
	<ul> <li>Knowledge on urban water infrastructures, ir</li> </ul>	particular drinking water systemsand u	urban drainag	e systems includi	
	special structures		-	-	
	Hydraulics of drinking water supply systems and	d sewer systems			
	<ul> <li>Basic knowledge on water management</li> </ul>				
Educational Objectives	After taking part successfully, students have reached	he following learning results			
Professional Competence					
Knowledge	The students are able to describe the modelling of groundwater flow and transport as well as urban water infrastructures. The			astructures. They o	
carry out systems analyses and can detect technical and conceptual weak points within the systems in case stu			studies. Besides th		
	are able to analyse interdependencies of hydraulic and	toxic phenomena in soil and water.			
Skills	The students are able to construct and apply scientif	ic aroundwater models indipendently. The	w can work o	n different consri	
JKIIIS	Skills The students are able to construct and apply scientific groundwater models indipendently. They can work on different solutions for existing problems by application of selected software products. The				
	and can compare or assess different solutions for existing problems by application of selected software products. The s able to use different software solutions (e.g. EPANET, EPA-SWMM).				
Personal Competence					
-	Wird nicht vermittelt.				
Autonomy	Wird nicht vermittelt.				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	0			
Credit points	6				
Course achievement	None				
Examination	Oral exam				
Examination duration and	20 min				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Engineering Civil Engineering: Specialisation Geotechnical Enginee	, , ,			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering:	5 1 5			
	Civil Engineering: Specialisation Coastal Engineering. Civil Engineering: Specialisation Water and Traffic: Ele	, ,			
	Water and Environmental Engineering: Specialisation				
	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
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Sonja Götz
Language	DE/EN
Cycle	SoSe
Content	Introduction and application of the groundwater model MODFLOW (PMWIN); theoretical backround of the modell, students do work
	with the model PMWIN for practical case studies.
Literature	MODFLOW-Handbuch
	Chiang, Wen Hsien: PMWIN

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

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

Courses				
Title		Тур	Hrs/wk	СР
Noise Protection (L1109)		Lecture	2	2
Urban Infrastructures (L0874)		Project-/problem-based Learning	2	4
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
<b>Recommended Previous</b>	Knowledge on Urban planning			
Knowledge	<ul> <li>Knowledge on measures for climate protection</li> </ul>			
	General knowledge of scientific writing/working			
	General knowledge of scientific writing/working			
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	Students can describe urban development corridors as well as	current and future urban environr	mental probler	ns. They are able
	explain the causes of environmental problems (like noise).			
	Students can specify applications for various technical innovation	ons and explain why these contril	bute to the im	provement of urb
	life. They can, for example, derive and discuss measures for effective noise abatement.			
CL 111	Skills Students are able to develop specific solutions for correcting existing or future environment-related problems of development. They can define a range of conceptual and technical solutions for environmental problems for different develop paths. To solve specific urban environmental problems they can select technical innovations and integrate them into the			
Skills				
	context.	an select technical innovations a	nu integrate t	nem into the urb
Personal Competence				
•	The students can work together in international groups.			
Social competence	The stadents can work together in international groups.			
Autonomy	Students are able to organize their work flow to prepare themselves for presentations and contributions to the discussions. Th			
	can acquire appropriate knowledge by making enquiries independently.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement	None			
	Written elaboration			
Examination duration and	Written Report plus oral Presentation			
scale				
	Civil Engineering: Specialisation Structural Engineering: Elective	Compulsory		
-	Civil Engineering: Specialisation Geotechnical Engineering: Elective			
	Civil Engineering: Specialisation Coastal Engineering: Elective C			
	Civil Engineering: Specialisation Water and Traffic: Elective Com			
	Environmental Engineering: Core Qualification: Elective Comput			
	Joint European Master in Environmental Studies - Cities and Sus		npulsory	
	Logistics, Infrastructure and Mobility: Specialisation Infrastructu	•		
	Water and Environmental Engineering: Specialisation Environme		-	
	water and Environmental Engineering. Specialisation Environme			

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

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

Courses				
		-	11	<u></u>
<b>Title</b> Coastal- and Flood Protection (L08)	10)	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 3
Coastal- and Flood Protection (L080		Project-/problem-based Learning	1	1
Maintennance and Defence of Floo	-	Lecture	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
<b>Recommended Previous</b>	Coastal Engineering I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the fol	llowing learning results		
<b>Professional Competence</b>				
Knowledge	The students have the capability to define and explain in c	detail the important aspects of erosi	on protection	and flood protect
	and are able to apply the aspects to practical coastal protection problems. They are able to design and dimension importan			
	coastal protection measures from the functional and from th	ne constructional point of view.		
<i></i>	L		<i>c</i>	
Skills	The students are able to select design approaches for the functional and constructional design of erosion and flood protection			
	measures and apply these approaches to practical design ta	isks.		
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in	n applied problems such as the fund	ctional and co	onstructive design
	coastal and flood protection structures. Additionaly, they wil	Il be able to work in team with engine	eers of other d	lisciplines.
Autonomy	The students will be able to independently extend their know	wledge and apply it to new problems		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 130 min. The examination includes tasks with respect to the general understanding of			
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elec	ctive Compulsory		
	Civil Engineering: Specialisation Geotechnical Engineering: E	Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: I	Liective compuisory		

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

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

Course L1411: Maintennance	and Defence of Flood Protection Structures
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Olaf Müller
Language	DE
Cycle	SoSe
Content	<ul> <li>Dike protection</li> <li>Maintennance of flood protection measures</li> </ul>
Literature	Vorlesungsumdruck

Courses				
Title		Тур	Hrs/wk	СР
Harbour Engineering (L0809)		Lecture	2	2
Harbour Engineering (L1414)		Project-/problem-based Learning	1	2
Port Planning and Port Construction	n (L0378)	Lecture	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
<b>Recommended Previous</b>	Basics of coastal engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
Knowledge	The students are able to define in details and to choose design approaches for the functional design of a port and apply ther			
	design tasks. They can design the fundamental elements of a	port.		
Skills	The students are able to select and apply appropriate approac	hes for the functional design of po	rts.	
Personal Competence				
	The students are able to deploy their gained knowledge in a	pplied problems such as the funct	tional design	of ports. Addition
,	they will be able to work in team with engineers of other disci		5	
Autonomv	The students will be able to independently extend their knowle			
,	Independent Study Time 110, Study Time in Lecture 70			
Credit points				
Course achievement				
Examination	Written exam			
Examination duration and	The duration of the examination is 150 min. The examination	on includes tasks with respect to	the general u	understanding of
	lecture contents and calculations tasks.		j.	<b>j</b>
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Electiv	e Compulsory		
-	Civil Engineering: Specialisation Geotechnical Engineering: Ele			
<b>2</b>	Civil Engineering: Specialisation Coastal Engineering: Compuls			
	Civil Engineering: Specialisation Water and Traffic: Elective Co	•		
	International Management and Engineering: Specialisation II. (			

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Hydraulic Models (L0813)		Project-/problem-based Learning	1	1
Modelling of Waves (L0812)		Project-/problem-based Learning	1	1
Modelling of Flow in Rivers and Est	aries (L0810)	Lecture	3	4
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
<b>Recommended Previous</b>	Coastal Hydraulic Engineering I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	Students are able to define in detail the basic processes that are related to the modelling of flows in hydraulic engineering			
	Besides, they can describe the basic aspects of numerical modelling and actual numerical models for the simulation of flow			nulation of flows a
	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 tear			
	with others.			
	The students will be able to independently extend their	knowledge and apply it to new problems.		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 3 hours. The exam	nination includes tasks with respect to	the general ι	understanding of t
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural Engineering:	Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineeri	ng: Elective Compulsory		
ronoming curriculu				

Course L0813: Hydraulic Mod	Course L0813: Hydraulic Models	
Тур	Project-/problem-based Learning	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Peter Fröhle	
Language	DE/EN	
Cycle	SoSe	
Content	<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
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Peter Fröhle
Language	DE/EN
Cycle	SoSe
Content	<ul> <li>Waves, interactions with shallow water and constructions</li> <li>Wave theories</li> <li>Sea state and surges</li> <li>Development of waves</li> <li>Wave spectra</li> <li>Modelling of Waves / phase averaged and phase resolved models</li> <li>Application of a phase averaged model for wave prediction (SWAN)</li> <li>Application of phase resolved wave models (Mike)</li> </ul>
Literature	Vorlesungsumdruck

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

Courses					
Title		Тур		Hrs/wk	СР
Wastewater Systems - Collection, T	reatment and Reuse (L0934)	Lecture		2	2
Wastewater Systems - Collection, T	reatment and Reuse (L0943)	Recitation	Section (large)	1	1
Advanced Wastewater Treatment (	L0357)	Lecture		2	2
Advanced Wastewater Treatment (	L0358)	Recitation	Section (large)	1	1
Module Responsible	Prof. Ralf Otterpohl				
Admission Requirements	None				
<b>Recommended Previous</b>	Knowledge of wastewater management an	nd the key processes involved in	wastewater treatm	ent.	
Knowledge					
Educational Objectives	After taking part successfully, students ha	ve reached the following learning	g results		
<b>Professional Competence</b>					
Knowledge	Students are able to outline key areas of t	the full range of treatment system	ms in waste water	management, as	well as their mut
	dependence for sustainable water protecti	on. They can describe relevant e	conomic, environm	nental and social	factors.
CL ///-					6 (b) - 1 1 1 1
SKIIIS	Students are able to pre-design and explain the available wastewater treatment processes and the scope of their application				
	municipal and for some industrial treatment	nt plants.			
Personal Competence					
Social Competence	Social skills are not targeted in this module.				
Autonomy	Students are in a position to work on a	subject and to organize their w	ork flow independ	ently. They can	also present on t
	subject.				
Workload in Hours	Independent Study Time 96, Study Time in	n Lecture 84			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	120 min				
scale					
Assignment for the	Civil Engineering: Specialisation Structural	Engineering: Elective Compulso	у		
Following Curricula	Civil Engineering: Specialisation Geotechni	ical Engineering: Elective Compu	lsory		
	Civil Engineering: Specialisation Coastal Er	ngineering: Elective Compulsory			
	Civil Engineering: Specialisation Water and	d Traffic: Compulsory			
	Bioprocess Engineering: Specialisation A -	General Bioprocess Engineering:	Elective Compulso	ory	
	Environmental Engineering: Specialisation	Water: Elective Compulsory			
	International Management and Engineering	g: Specialisation II. Process Engir	eering and Biotech	nnology: Elective	Compulsory
	International Management and Engineering	g: Specialisation II. Energy and E	nvironmental Engir	neering: Elective	Compulsory
	Process Engineering: Specialisation Enviro	nmental Process Engineering: Ele	ective Compulsory		
	Process Engineering: Specialisation Proces	s Engineering: Elective Compuls	ory		
	Water and Environmental Engineering: Spe	ecialisation Water: Compulsory			
	Water and Environmental Engineering: Spe	ecialisation Environment: Elective	e Compulsory		
	Water and Environmental Engineering: Spe				

## Course L0934: Wastewater Systems - Collection, Treatment and Reuse

Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
Content	•Understanding the global situation with water and wastewater
	•Regional planning and decentralised systems
	•Overview on innovative approaches
	•In depth knowledge on advanced wastewater treatment options for different situations, for end-of-pipe and reuse
	•Mathematical Modelling of Nitrogen Removal
	•Exercises with calculations and design
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 S	rse L0943: Wastewater Systems - Collection, Treatment and Reuse	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Ralf Otterpohl	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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

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

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

Course L1066: City Planning		
Тур	Project-/problem-based Learning	
Hrs/wk	4	
CP	6	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Prof. Carsten Gertz	
Language	DE	
Cycle	SoSe	
Content	"Principles of Urban Planning" deals with the determinants of urban development and their interactions. Topics include:	
	<ul> <li>legal framework,</li> <li>instruments and methods of planning,</li> <li>functional requirements,</li> <li>stakeholders and actors</li> <li>basic design requirements</li> <li>different planning levels and</li> <li>historical contexts.</li> </ul> The objective of the course is for students to acquire a basic understanding of urban development problems and approaches for solving them. They will also be able to comprehend the process of urban planning. The course also covers the various functional and aesthetic requirements for designing streetscape as the most important elements of public space. The project work deals with a real life scenario and includes drawing up a development plan, an urban design concept, a building masterplan and a street redesign.	
Literature	Albers, Gerd; Wekel, Julian (2009) Stadtplanung: Eine illustrierte Einführung. Primus Verlag. Darmstadt. Frick, Dieter (2008) Theorie des Städtebaus: Zur baulich-räumlichen Organisation von Stadt. Wasmuth-Verlag. Tübingen Jonas, Carsten (2009) Die Stadt und ihr Grundriss. Wasmuth-Verlag. Tübingen Kostof, Spiro; Castillo, Greg (1998) Die Anatomie der Stadt. Geschichte städtischer Strukturen. Campus-Verlag. Frankfurt/New York.	

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Courses				
Title	Тур	p	Hrs/wk	СР
Construction Logistics (L1163)		ture	1	2
Construction Logistics (L1164)		citation Section (small)	1	2
Project Development and Managen Project Development and Managen		cture vject-/problem-based Learning	1	1
		Ject-/problem-based Learning	1	1
Module Responsible Admission Requirements	None			
Recommended Previous	none			
Knowledge	none			
	After taking part successfully, students have reached the following le	earning results		
Professional Competence	After taking part successfully, students have reached the following le	saming results		
	Students can			
Kilowiedge	Students can			
	<ul> <li>give definitions of the main terms of construction logistics and</li> </ul>	d project development and ma	anagement	
	<ul> <li>name advantages and disadvantages of internal or external control</li> </ul>	onstruction logistics		
	<ul> <li>explain characteristics of products, demand and production of</li> </ul>	f construction objects and the	eir consequer	nces for construction
	specific supply chains			
	<ul> <li>differentiate constructions logistics from other logistics system</li> </ul>	ns		
Skills	Students can			
	carry out project life cycle assessments			
	apply methods and instruments of construction logistics			
	<ul> <li>apply methods and instruments of project development and methods</li> </ul>	nanagement		
	apply methods and instruments of conflict management     design supply and waste removal concerts for a construction	project		
	<ul> <li>design supply and waste removal concepts for a construction</li> </ul>	project		
Personal Competence				
Social Competence	Students can			
	<ul> <li>hold presentations in and for groups</li> </ul>			
	<ul> <li>apply methods of conflict solving skills in group work and case</li> </ul>	a studios		
	• apply methods of connect solving skins in group work and case	, studies		
Autonomy	Students can			
	<ul> <li>solve problems by holistic, systemic and flow oriented thinking</li> </ul>	a		
	<ul> <li>improve their creativity, negotiation skills, conflict and crise</li> </ul>		methods of	moderation in ca
	studies	is senation shine by applying	incentous of	
	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Two written papers with presentations			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Com			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective C	1 3		
	Civil Engineering: Specialisation Coastal Engineering: Elective Compu			
	Civil Engineering: Specialisation Water and Traffic: Elective Compulso			
	International Management and Engineering: Specialisation II. Civil En		ory	
	International Management and Engineering: Specialisation II. Logistic			
	Logistics, Infrastructure and Mobility: Specialisation Production and L			
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure an	in mobility. Elective Compulse	лу	

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

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

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

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

	Hrs/wk	СР
	2	2
Section (large)	2	2
	1	1
Section (large)	1	1
None Knowledge of linear structural analysis of statically determinate and indeterminate structures; Mechanics I/II, Mathematic		
g results		
basic aspects of dyn	namic effects o	on structures and t
to predict the respo thods.	onse of mater	ial and structures
icism		
her sources and app	ply it to new pr	oblems. Furthermo
Structural Analysis.		
Isorv		
lsory		
lsory	1	
	lsory	lsory ing: Elective Compulsory

Course L1202: Structural Dy	namics
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	SoSe
Content	<ul> <li>Single-degree-of-freedom systems: undamped and damped vibration, free vibration, forced vibrations due to harmonic, periodical or arbitrary loading, natural frequency, damping</li> <li>vibration isolation</li> <li>solution in the frequency-domain (Fourier transformation), solution in the time-domain</li> <li>multi-degree-of-freedom systems: continuous or discrete systems, modelling with finite elements, generalisation</li> <li>modal analysis</li> <li>power iteration according to v.Mises</li> <li>earthquake loading: seismological basics, response spectrum method</li> <li>wind-induced vibrations: engineering meteorology, aerodynamic, classification of excitation mechanisms</li> </ul>
Literature	Clough, R.W., Penzien, J.: Dynamics of Structures. 2. Aufl., McGraw-Hill, New York, 1993.

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

Тур	Lecture
Hrs/wk	
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Jürgen Priebe
Language	DE
Cycle	SoSe
Content	<ul> <li>basics of fatigue stress and fatigue resistance and determination of fatigue strength,</li> </ul>
	determination and use of S-N-curves and classification of notch effects,
	• set up of determination of fatigue strength under dynamic load using the accumulation formula by Palmgren-Miner,
	<ul> <li>set up of determination of fatigue strength in different examples,</li> </ul>
	<ul> <li>basics of construction and design regarding the problem of material fatigue,</li> </ul>
	<ul> <li>basics of linear elastic fracture mechanics under static and dynamic load,</li> </ul>
	determination of lifetime of steel construction based on linear elastic fracture mechanics in different examples.
Literature	Seeßelberg, C.; Kranbahnen - Bemessung und konstruktive Gestaltung; 3. Auflage; Bauwerk-Verlag; Berlin 2009
	Kuhlmann, Dürr, Günther; Kranbahnen und Betriebsfestigkeit; in Stahlbau Kalender 2003; Verlag Ernst & Sohn; Berlin 2003
	Deutscher Stahlbau-Verband (Hrsg.); Stahlbau Handbuch Band 1 Teil B; 3. Auflage; Stahlbau-Verlagsgesellschaft; Köln 1996
	Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993
	<ul> <li>DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsreg</li> <li>Bemessungsregeln f         ür den Hochbau; 1993</li> </ul>
	• DIN V ENV 1993-6: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 6: Kranbahnen; 2001
	• DIN-Fachbericht 126. Richtlinie zur Anwendung von DIN V ENV 1993-6; Nationales Anwendungsdokument (NAD); Berlin 200

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

Courses				
Title		Тур	Hrs/wk	СР
Steel Construction Project (L1206)		Project Seminar	4	6
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
<b>Recommended Previous</b>	Steel and Composite Structures			
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	Students are able to prepare a part of the wh	nole project and explain it to the others.		
Skills	Students can produce sketches and calcula	tions of their part of the project. They are	e able to adjust their	r work in reaction
	changing conditions resulting from other par	ticipants of the project.		
Personal Competence				
Social Competence	Students can present their results to other m	embers of the group.		
	They have the ability to work for a broad agreement with respect to intergroup dependencies.			
	They have the ability to work for a broad agreement with respect to intergroup dependencies.			
	They can distribute and process tasks indepe	endently.		
Autonomy	Students can handle their part of the project	on their own resposibility-		
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	approx. 15-20 pages (without appendix)			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnica	l Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Eng	neering: Elective Compulsory		
	Civil Engineering: Specialisation Structural E	aineering: Compulsory		

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

Courses				
Title		Тур	Hrs/wk	СР
Marine Geotechnics (L0548)		Lecture	1	2
Marine Geotechnics (L0549)		Recitation Section (large)	2	2
Steel Structures in Foundation and	Hydraulic Engineering (L1146)	Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>	complete modules: Geotechnics I-III, Mathem	atics I-III		
Knowledge				
	courses: Soil laboratory course			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnica	l Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Structural Er	igineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engi	neering: Compulsory		
	Theoretical Mechanical Engineering: Specialis	sation Maritime Technology: Elective Compulsory	1	
	Water and Environmental Engineering: Speci			
	Water and Environmental Engineering: Speci-			
	Water and Environmental Engineering: Speci	alisation Water: Elective Compulsory		

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

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

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

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

Course L2762: Smart Monito	ring
Тур	Integrated Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	In this course, principles of smart monitoring will be taught, focusing on modern concepts of data acquisition, data storage, and data analysis. Also, fundamentals of intelligent sensors and embedded computing will be illuminated. Autonomous software and decentralized data processing are further crucial parts of the course, including concepts of the Internet of Things, Industry 4.0 and cyber-physical systems. Furthermore, measuring principles, data acquisition systems, data management and data analysis algorithms will be discussed. Besides the theoretical background, numerous practical examples will be shown to demonstrate how smart monitoring may advantageously be used for assessing the condition of systems in the built or natural environment.
Literature	

Course L2763: Smart Monito	ring
Тур	Recitation Section (small)
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	The contents of the exercises are based on the lecture contents. In addition to the exercises, project work will be conducted, which will consume the majority of the workload. As part of the project work, students will design smart monitoring systems that will be tested in the laboratory or in the field. As mentioned in the module description, the students will participate in the "Smart Monitoring" competition, hosted annually by the Institute of Digital and Autonomous Construction. Students are encouraged to contribute their own ideas. The tools required to implement the smart monitoring systems will be taught in the group exercises as well as through external sources, such as video tutorials and literature.
Literature	

-				
Courses				
Title		Тур	Hrs/wk	СР
Water Protection and Wastewater I	-	Lecture Project Seminar	3	3 3
Water Protection and Wastewater Module Responsible		Project Seminar	3	5
Admission Requirements				
Recommended Previous	None			
Knowledge	<ul> <li>Basic knowledge in water manageme</li> </ul>	ent;		
J.	<ul> <li>Good knowledge in urban drainage;</li> </ul>			
	Good knowledge of wastewater treat			
	Good knowledge of pollutants (e.g. C	OD, BOD, TS, N, P) and their properties;		
Educational Objectives	After taking part successfully, students have	e reached the following learning results		
Professional Competence				
Knowledge	The students can describe the basic princip	les of the regulatory framework related to th	e international and Eu	ropean water sect
	They can explain limnological processes,	substance cycles and water morphology in	detail. They are able	e to assess compl
		as ecosystem service and wastewater tre	atment with a special	focus on innovati
	solutions, remediation measures as well as	conceptual approaches.		
Skills	Students can accurately assess current pro	blems and situations in a country-specific o	r local context. They o	can suggest concre
	actions to contribute to the planning of t	omorrow's urban water cycle. Furthermore,	, they can suggest a	ppropriate technic
	administrative and legislative solutions to se	olve these problems.		
Personal Competence				
Social Competence	The students can work together in internation	onal groups.		
Autonomy	Students are able to organize their work flo	ow to prepare presentations and discussions	They can acquire an	propriate knowled
hatohomy	by making enquiries independently.		. They can acquire up	
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points				
Course achievement				
Examination	Presentation			
Examination duration and scale	Term paper plus presentation			
Scale				
Assignment for the	Civil Engineering: Specialisation Structural E	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnic			
	Civil Engineering: Specialisation Coastal Eng	, ,		
	Civil Engineering: Specialisation Water and			
	Environmental Engineering: Specialisation V		Commute	
		Specialisation II. Civil Engineering: Elective		
		dies - Cities and Sustainability: Specialisation	i water: Elective Comp	buisory
	Water and Environmental Engineering: Spec			
	Water and Environmental Engineering, Spec	cialisation Water: Elective Compulsory		

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

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

Courses				
Title		Тур	Hrs/wk	СР
Examination of Materials, Structura	-	Lecture	3	4
Examination of Materials, Structura	I Condition and Damages (L0261)	Recitation Section (small)	1	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
<b>Recommended Previous</b>	Basic knowledge about building materials or r	naterial science, for example by the mo	dule Building Ma	aterials and Buildi
Knowledge	Chemistry.			
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
Professional Competence				
Knowledge	The students are able to describe the rules for the	rading, use and marking of construction pr	oducts in Germai	ny. They know whi
	methods for the testing of building material prope	erties are usable and know the limitations a	nd characterics o	of the most importa
	testing methods.			
Skille	The students are able to responsibly discover the	rules for trading and using of building prod	icts in Germany	
JKIIIS	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 an			
	the examination of the structural conditions of bu	• • •		•
	are able to describe an examination in form of a	• • •	iptono to the cuu	se of duringes. If
Personal Competence				
Social Competence				ion bodies within
	framework of material testing. They can describe	the different roles of the participants in leg	al proceedings.	
Autonomy	The students are able to make the timing and the	operation steps to learn the specialist know	vledge of a very e	extensive field.
Workload in Hours	Independent Study Time 124, Study Time in Lectu	ıre 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engine	ering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Eng	ineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineer	ing: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic	:: Elective Compulsory		
	International Management and Engineering: Spec	ialisation II. Civil Engineering: Elective Com	oulsory	
	Materials Science: Specialisation Engineering Mat	erials: Elective Compulsory		

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

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

Courses						
Title			Тур		Hrs/wk	СР
Concrete Structures (L0579)			Seminar		1	1
Structural Concrete Members (L05			Lecture		2	3
Structural Concrete Members (L05	- /		Recitatio	n Section (large)	2	2
Module Responsible		ach				
Admission Requirements	None					
Recommended Previous	Basics of structural	analysis, conception ar	nd dimensioning of structural co	oncrete		
Knowledge	Modules: Reinforce	d Concrete Structures I	+II, Structural Analysis I+II, Me	chanics I+II		
			, , , , , , , , , , , , , , , , , , ,			
Educational Objectives	After taking part su	ccessfully, students hav	ve reached the following learning	ng results		
Professional Competence						
Knowledge	The students broad	len their skills in structu	aral engineering, especially in t	ne field of buildings	(houses, roofs, ha	alls). They dispos
	the knowledge for t	the conception and desi	ign of concrete buildings and st	ructural members t	hat are often used	d.
Chille	The students are a	bla ta angli gana angli gan	<b>f</b> + h + i			
SKIIIS	The students are able to apply procedures of the conception and dimensioning to to practical problems of structural engine They are capable to draft concrete buildings and to design them for general action effects and to plan their detailin				•	
				-		their detailing
	execution. Moreove	er, they can make desig	n and construction sketches ar	d draw up technica	descriptions.	
Personal Competence						
Social Competence	The students are al	ble to obtain results of h	nigh quality in teamwork.			
Autonomy	The students are ab	ole to carry out complex	conception and dimensioning	tasks of structures	under the guidan	ce of tutors.
Workload in Hours	Independent Study	Time 110, Study Time	in Lecture 70			
Credit points	6					
Course achievement	Compulsory Bonus	Form	Description			
	Yes None	Presentation	Es werden 2 Referate	ausgegeben		
Examination	Written exam					
Examination duration and	120 minutes					
Examination duration and						
scale		pecialisation Structural	Engineering: Compulsory			
scale	Civil Engineering: S	pecialisation seractara	3			
scale	• •	•	ical Engineering: Elective Comp	ulsory		
scale Assignment for the	Civil Engineering: S	pecialisation Geotechni				
scale Assignment for the	Civil Engineering: S Civil Engineering: S	pecialisation Geotechni pecialisation Coastal Er	ical Engineering: Elective Comp			

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

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

		Тур	_	Hrs/wk	СР	
					2	
1		roject-/pi	oblem-based Learning	5	7	
chemical and biologic	al basics					
After taking part que	accfully, ctudents have re	ached the following learning	, reculto			
Alter taking part succ	essiully, students have re	actied the following learning	JTESUILS			
The meeting sime as		a the planning of high size		ha. Churdanata au	e abla ta avalain i	
-						
				echniques for	waste gas treatine	
plants for biological v	laste treatment plants an	a explain amerent methods	for waste analytics.			
The students are able	a ta dissuss the compilatio	n of docian and lavout of pl	ante They can critical	lu ovoluoto to	chairway and gual	
					given in der mod	
	.sts. They are capable of	cheeting and evaluating init	angs in the group.			
Students can particir	vate in subject-specific ar	d interdisciplinary discussio	uns develon cooperate	d solutions a	nd defend their o	
Students can indepe	ndently tap knowledge fr	om literature, business or te	est reports and transfo	rm it to the c	ourse proiects. Th	
are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define further						
-						
-						
Independent Study T	ime 110, Study Time in Le	cture 70				
6						
Compulsory Bonus	Form	Description				
Yes None	-	and				
	practical work					
Presentation						
Elaboration and Prese	entation (15-25 minutes in	groups)				
5 5 1	5	5	5			
• • •			Isory			
	-					
Civil Engineering: Spe	ecialisation Water and Tra	Inc. Elective Compulsory				
Environment of the Environment		Communication				
Environmental Engine	-		nuirenment-I Errice	dina. Election	Compulser	
International Manage	ment and Engineering: Sp	ecialisation II. Energy and E				
International Manage Joint European Maste	ment and Engineering: Sp r in Environmental Studie		Specialisation Energy:			
	After taking part succ The module aims pos design and layout of a plants for biological w The students are able control measurement and plan additional te Students can particip work results in front accept professional co Students can indeper are capable, in consu steps on this basis. F potential social, econ Independent Study Ti 6 Compulsory Bonus Yes None Presentation Elaboration and Prese Civil Engineering: Spe Civil Engineering: Spe	Prof. Kerstin Kuchta         None         chemical and biological basics         After taking part successfully, students have re         The module aims possess knowledge concernir         design and layout of anaerobic and aerobic wa         plants for biological waste treatment plants and         The students are able to discuss the compilation         control measurements. The students can recharant plan additional tests. They are capable of r         Students can participate in subject-specific an work results in front of others and promote thaccept professional constructive criticism.         Students can independently tap knowledge from are capable, in consultation with supervisors as steps on this basis. Furthermore, they can deferred are capable, in consultation with supervisors as steps on this basis. Furthermore, they can deferred are capable, social, economic and cultural impact.         Independent Study Time 110, Study Time in Le         6         Compulsory Bonus       Form         Yes       None       Subject theoretical practical work         Presentation       Elaboration and Presentation (15-25 minutes in Civil Engineering: Specialisation Structural Engineering: Specialisation Geotechnical Engineering: Specialisation Structural Engin Supervision Supervision Supervision Supervi	y (L0328)       Practical C         Project-/pr         Prof. Kerstin Kuchta         None         chemical and biological basics         After taking part successfully, students have reached the following learning         The module aims possess knowledge concerning the planning of biological design and layout of anaerobic and aerobic waste treatment plants in deta plants for biological waste treatment plants and explain different methods         The students are able to discuss the compilation of design and layout of pl control measurements. The students can recherché and evaluate literatur and plan additional tests. They are capable of reflecting and evaluating find         Students can participate in subject-specific and interdisciplinary discussio work results in front of others and promote the scientific development i accept professional constructive criticism.         Students can independently tap knowledge from literature, business or te are capable, in consultation with supervisors as well as in the interim presesteps on this basis. Furthermore, they can define targets for new applica potential social, economic and cultural impact.         Independent Study Time 110, Study Time in Lecture 70       6         Computory Bonus       Form       Description         Yes       Subject theoretical and practical work       Presentation         Elaboration and Presentation (15-25 minutes in groups)       Civil Engineering: Elective Compulsor	y (L0328)       Practical Course Project-/problem-based Learning         Porf. Kerstin Kuchta       None         Chemical and biological basics       After taking part successfully, students have reached the following learning results         The module aims possess knowledge concerning the planning of biological waste treatment plant design and layout of anaerobic and aerobic waste treatment plants in detail, describe different to plants for biological waste treatment plants and explain different methods for waste analytics.         The students are able to discuss the compilation of design and layout of plants. They can critical control measurements. The students can recherché and evaluate literature and date connected and plan additional tests. They are capable of reflecting and evaluating findings in the group.         Students can participate in subject-specific and interdisciplinary discussions, develop cooperate work results in front of others and promote the scientific development in front of colleagues accept professional constructive criticism.         Students can independently tap knowledge from literature, business or test reports and transfor are capable, in consultation with supervisors as well as in the interim presentation, to assess the steps on this basis. Furthermore, they can define targets for new application-or research-orient potential social, economic and cultural impact.         Independent Study Time 110, Study Time in Lecture 70       6         Computary Bonus       Form       Description         Yes       None       Subject theoretical and practical work       Presentation         Elaboration       Subject th	y (10328)       Practical Course       2         Prof. Kerstin Kuchta       3         None	

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

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

Courses							
Title					_	Line (colo	СР
Computational Analysis of Concret	- Etructuros /			Туј	<b>p</b> ture	Hrs/wk 2	3
Computational Analysis of Concrete Computational Analysis of Concrete					itation Section (large)	2	3
FE-Modeling of Concrete Structures		20555)			ject-/problem-based Learning	2	2
Module Responsible	1	er Romba	ch				
Admission Requirements	None						
<b>Recommended Previous</b>	Basic know	ledge in :	structural analysis and	design of reinforced conci	rete structures (beams, slabs	s, shear walls	
Knowledge	Lectures '	Concrete	Structures I und II'				
	Lectures 'S	Structural	Analysis I and II'				
	Lecture 'Co	oncroto St	tructures				
	Lecture Ct	Silciele Si	liuctures				
Educational Objectives	After takin	g part suc	ccessfully, students hav	ve reached the following le	earning 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							
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 proble and results with other students.						
Workload in Hours		nt Study	Time 110, Study Time i	in Lecture 70			
Credit points	6	-	Form				
Course achievement	Compulsory Yes	None	Excercises	Description	tem mit TEDDY zu modellier		
	Yes		Attestation	• ,			ochonprogramm
	Tes	None	Attestation	modellieren	iemster ist ein Tragsystem	i mit dem R	echenprogramm .
Examination	Oral exam						
Examination duration and	45 min						
scale							
Assignment for the	Civil Engin	eering: Sp	pecialisation Structural	Engineering: Elective Corr	pulsory		
5	5	• •		ical Engineering: Elective C			
-	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory						
5	Civil Engin	eering: Sp	pecialisation Geotechni	ical Engineering: Elective C	Compulsory		

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Chemistry of Drinking Water Treatr	nent (L0311)	Lecture	2	1
Chemistry of Drinking Water Treatr	nent (L0312)	Recitation Section (large)	1	2
Water Resource Management (L04)	02)	Lecture	2	2
Water Resource Management (L04)		Recitation Section (small)	1	1
Module Responsible				
Admission Requirements	None			
<b>Recommended Previous</b>	Knowledge of water management and the	key processes involved in water treatment.		
Knowledge				
Educational Objectives	After taking part successfully, students ha	we reached the following learning results		
Professional Competence				
Chille	outline the organisational structures of water companies. They will be able to explain the available water treatment processes a the scope of their application.			
361/3	Students will be able to assess complex problems in drinking water production and establish solutions involving wat management and technical measures. They will be able to assess the evaluation methods that can be used for this. Students w be able to carry out chemical calculations for selected treatment processes and apply generally accepted technical rules a standards to these processes.			
Personal Competence				
Social Competence	Working in a diverse group of specialists, students will be able to develop and document complex solutions for the manageme			
	• •	ill be able to take an appropriate professional at solutions in teams of diverse experts and prese		
Autonomy	Students will be in a position to work on a	subject independently and present on this subje	ct.	
Workload in Hours	Independent Study Time 96, Study Time ir	n Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min (chemistry) + presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structural	l Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechn	ical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and	d Traffic: Compulsory		
	Civil Engineering: Specialisation Coastal E	ngineering: Elective Compulsory		
	International Management and Engineerin	g: Specialisation II. Energy and Environmental Er	ngineering: Elective	Compulsory
	Process Engineering: Specialisation Enviro	onmental Process Engineering: Elective Compulso	ry	
	Process Engineering: Specialisation Proces	ss Engineering: Elective Compulsory		
	Water and Environmental Engineering: Sp	ecialisation Water: Compulsory		
	Water and Environmental Engineering: Sp	ecialisation Environment: Elective Compulsory		

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

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

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

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

Courses				
Title	Тур		Hrs/wk	СР
Integrated Transportation Planning	(L1068) Project-/	problem-based Learning	4	6
Module Responsible	Prof. Carsten Gertz			
Admission Requirements	None			
<b>Recommended Previous</b>	some knowledge of transport planning, e.g. through taking the undergrad	luate class "Transport Pl	anning and Tr	affic Engineerin
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning	ng results		
Professional Competence				
Knowledge	Students are able to:			
	describe interdependencies between land-use/location choice and	transportation/mobility I	pehaviour	
	explain and evaluate the social, ecological and economic effects of	f transport and land-use	policy measu	es.
	relate current issues in the area of integrated transport planning an	nd formulate an opinion	on them.	
Skills	Students are able to:			
	guantify important parameters, which influence travel demand or a	are influenced by it		
	<ul> <li>comprehensively examine a pre-defined or self-selected topic from</li> </ul>	-	os nersnective	and document t
	results in accordance with scientific conventions.		is perspective	
Personal Competence				
Social Competence	Students are able to:			
	<ul> <li>provide feedback on topical contents and their teaching.</li> </ul>			
	<ul> <li>constructively handle feedback on their own work.</li> </ul>			
	<ul> <li>produce results in group work and document these.</li> </ul>			
Autonomy	Studente are able ta			
Autonomy	Students are able to:			
	<ul> <li>assess potential consequences of their future professional activities</li> </ul>	S		
	<ul> <li>independently plan working on a pre-defined project topic, acquire</li> </ul>	the necessary knowled	ge and use ap	propriate means
	its execution.			
Warkland in Haura	Independent Study Time 124, Study Time in Lesture EC			
Credit points	Independent Study Time 124, Study Time in Lecture 56			
Course achievement				
Examination	Written elaboration			
Examination duration and	written assignment with presentation during the semester			
scale				
-	Civil Engineering: Specialisation Structural Engineering: Elective Compuls			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Comp	5		
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory	у		
	Civil Engineering: Specialisation Water and Traffic: Compulsory			
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mo	,	огу	
	Water and Environmental Engineering: Specialisation Water: Elective Con Water and Environmental Engineering: Specialisation Environment: Electi			
	Water and Environmental Engineering: Specialisation Environment: Electi Water and Environmental Engineering: Specialisation Cities: Compulsory	ve compuisory		

Course L1068: Integrated Tr	ansportation Planning
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Carsten Gertz, Dr. Philine Gaffron, Jacqueline Bianca Maaß
Language	DE
Cycle	WiSe
	The course will provide students with an understanding of interdependencies between land-use and transportation. Specific topics include a.o.:    interactions between transport and the environment and consequent limitations  characteristics of integrated planning  complex planning processes  interdependencies of location choice and mobility behaviour  transport and land-use policies  project on current issues in transportation studies
Literature	Kutter, Eckhard (2005) Entwicklung innovativer Verkehrsstrategien für die mobile Gesellschaft. Erich Schmidt Verlag. Berlin. Bracher, Tilman u. a. (Hrsg.) (68. Ergänzung 2013) Handbuch der kommunalen Verkehrsplanung. Herbert Wichmann Verlag. Berlin, Offenbach. (Loseblattsammlung mit kontinuierlichen Ergänzungen)

Module M0963: Steel	and Composite Structures			
Courses				
litle		Tree	Hrs/wk	СР
Steel and Composite Structures (L1	204)	<b>Typ</b> Lecture	Hrs/wk 2	2
Steel and Composite Structures (L1		Recitation Section (large)	2	2
Steel Bridges (L1097)		Lecture	2	2
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
<b>Recommended Previous</b>	Basics of steel construction (i.e. Steel Structures I and II, BUBC)			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	After successful completition, students can			
	a describe the phonemonen of local building			
	describe the phenomenon of local buckling			
	explain warping torsion			
	illustrate the behaviour of composite structures			
	specify the principles in design of composite sttructures			
	sketch the contructions of steel and composite bridges			
Skills	After successful participation students are able to			
	<ul> <li>check stiffened and unstiffened plated structures</li> </ul>			
	<ul> <li>recognize and verify warping tosion in strucures</li> </ul>			
	<ul> <li>design composite structures</li> </ul>			
	design bridges and o perform the detailing			
Personal Competence				
Social Competence				
Autonomy	-			
,	Independent Study Time 96, Study Time in Lecture 84			
	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Compu	lsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elec	tive Compulsory		
-	Civil Engineering: Specialisation Coastal Engineering: Elective C			
	Civil Engineering: Specialisation Water and Traffic: Elective Con			
	International Management and Engineering: Specialisation II. Ci		oulsory	

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

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

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

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

## Module M0969: Selected Topics in Civil Engineering

	ted ropics in civil Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Ergonomics (L0653)		Lecture	2	3
Construction robotics (L0708)		Project-/problem-based Learning	3	3
Analysis of Offshore Structures (L18	367)	Lecture	1	1
Excellence in International Project	Delivery (L2387)	Integrated Lecture	2	2
Design of Prefabricated Concrete St	tructures (L0596)	Lecture	1	1
Design of Prefabricated Concrete St	tructures (L0597)	Recitation Section (large)	1	1
Forum I - Geotechnics and Construct	tion Management (L1634)	Seminar	1	1
Forum II - Geotechnics and Constru	ction Management (L1635)	Seminar	1	1
Geotechnical Engineering Design (L	.2447)	Lecture	2	3
Timber Structures (L1151)		Seminar	2	2
Innovative Timber Construction (L2	666)	Lecture	2	3
Glass Structures (L1152)		Lecture	2	2
Glass Structures (L1447)		Recitation Section (large)	1	1
-	nation of concrete members (L2725)	Project-/problem-based Learning	2	2
Special topics of civil engineering 1			1	1
Special topics of civil engineering 2			2	2
Special topics of civil engineering 3	LP (L2380)		3	3
Structural Design (L2789)		Seminar	2	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
Recommended Previous	none			
Knowledge				
Educational Objectives	After taking part successfully, students have reached	the following learning results		
Professional Competence				
Knowledge	<ul> <li>Students are able to find their way through sel</li> <li>Students are able to explain basic models and</li> <li>Students are able to interrelate scientific and to</li> </ul>	procedures in selected special areas of civi		-
Skills	• Students are able to apply basic methods in se	elected areas of civil and structural enginee	ring.	
Personal Competence				
Social Competence Autonomy	Students can chose independently, in which f	ields they want to deepen their knowledge	e and skills th	rough the election
	courses.			
Workload in Hours	courses. Depends on choice of courses			
Workload in Hours Credit points	Depends on choice of courses			
Credit points	Depends on choice of courses	ng: Elective Compulsory		
Credit points Assignment for the	Depends on choice of courses 6			
Credit points Assignment for the	Depends on choice of courses 6 Civil Engineering: Specialisation Structural Engineerin	ering: Elective Compulsory		

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

Course L0708: Construction	Course L0708: Construction robotics	
Тур	Project-/problem-based Learning	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Examination Form	Mündliche Prüfung	
Examination duration and	15 min	
scale		
Lecturer	Francisco Williams Riquer	
Language	DE	
Cycle	WiSe	
Content	The students learn in the lecture the required knowledge in control systems to apply it to a specific project-based geotechnical problem. In a two-weeks time frame, students can test developed control strategies in the lab and present their results. At the end of the lecture, students will have an oral examination.	
Literature	Ogata, Katsuhiko. Modern control engineering. Vol. 5. Upper Saddle River, NJ: Prentice hall, 2010. Ross, Timothy J. Fuzzy logic with engineering applications. John Wiley & Sons, 2005.	

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

Course L2387: Excellence in International Project Delivery	
	Integrated Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and	2 h
scale	
Lecturer	Dr. Jens Huckfeldt
Language	EN
Cycle	SoSe
Content	Simply and easy to avoid mistake in project delivery can deliver projects within budget and as per schedule.You
	have to attend if you see yourself in project execution and potentially even abroad.
Literature	

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

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

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

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

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

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

Course L2666: Innovative Timber Construction		
Тур	Lecture	
Hrs/wk	2	
CP	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Schriftliche Ausarbeitung	
Examination duration and	45 Minuten	
scale		
Lecturer	Dr. Andreas Meisel	
Language	DE	
Cycle	WiSe	
Content		
Literature	- Blass, J.: "Ingenieurholzbau"	
	- Schickhofer, G.: "BSPhandbuch: Holz-Massivbauweise in Brettsperrholz"	
	- Informationsdienst Holz: div. Merkblätter und Broschüren	
	- Wallner-Novak M.: Brettsperrholz Bemessung, Band 1 und 2	
	- Gerner M.: "Fachwerk: Entwicklung, Instandsetzung, Neubau"	
	- Meisel, A.: "Historische Dachwerke: Beurteilung, realitätsnahe statische Analyse und Instandsetzung"	
	- Kempe K.: "Dokumentation Holzschädlinge"	
	- Huckfeldt T.: "Hausfäule- und Bauholzpilze"	

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

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

Course L2725: Testing and non-destructive examination of concrete members		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Mündliche Prüfung	
Examination duration and	20 min	
scale		
Lecturer	Dr. Lukas Henze, Dr. Lukas Henze	
Language	DE	
Cycle	SoSe	
Content		
Literature		

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

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

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

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

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

Courses					
Title		Тур	Hrs/wk	СР	
Subsoil and Underground Engineering Law (L0395)		Lecture	2	3	
Service Contract and Procurement	Law (L1906)	Lecture	2	3	
Module Responsible	Prof. Jürgen Grabe				
Admission Requirements	None				
<b>Recommended Previous</b>	Complete modules: Geotechnics I-III				
Knowledge					
Educational Objectives	After taking part successfully, students have re	eached the following learning results			
<b>Professional Competence</b>					
Knowledge	Students will gain knowledge of				
	• the history of sivil angineering law				
	the history of civil engineering law,     basics of foundation and civil engineering law.				
	<ul> <li>basics of foundation and civil engineering law,</li> <li>logal accepts of technical regulations is givil engineering (with case studies)</li> </ul>				
	<ul> <li>legal aspects of technical regulations in civil engineering (with case studies),</li> <li>the civil engineering contract,</li> </ul>				
	<ul> <li>the civil engineering contract,</li> <li>the liability of the designer and contractor in civil engineering,</li> </ul>				
	<ul> <li>the lability of the designer and contractor in civil engineering,</li> <li>the subsoil risk and the system risk,</li> </ul>				
	<ul> <li>the subsolities and the system risk,</li> <li>the total debt in (civil) engineering law,</li> </ul>				
	<ul> <li>the (construction) conflict, dispute avoidance models and the construction process,</li> </ul>				
	<ul> <li>the (construction) connect, aspute avoidance models and the construction process,</li> <li>the systematics of construction contract law,</li> </ul>				
	<ul> <li>the BGB construction contract law,</li> </ul>				
	<ul> <li>responsibilities on the construction site,</li> </ul>				
	<ul> <li>responsibilities of the construction site,</li> <li>remuneration and contract management,</li> </ul>				
	<ul> <li>liability for defects,</li> </ul>				
	<ul> <li>public procurement law.</li> </ul>				
Skills	Students learn to apply legal aspects in planni	ng and construction in a legally balanced	way.		
Personal Competence					
	Students can work in groups and support each other in finding solutions.				
Autonomy	Students are able to assess their own strength	s and weaknesses and organize their tim	e and learning manage	ment based on th	
Workload in Hours	Independent Study Time 124, Study Time in Le	ecture 56			
Credit points	6				
Course achievement	None				
Examination	Oral exam				
Examination duration and	30 min				
scale					
Assignment for the	Civil Engineering: Specialisation Coastal Engine	eering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical	Engineering: Elective Compulsory			
	Civil Engineering: Specialisation Structural Eng	ineering: Elective Compulsory			
	Civil Engineering: Specialisation Water and Tra	ffic: Elective Compulsory			

Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Günther Schalk
Language	DE
Cycle	WiSe
Content	History of Civil Engineering Law (from 1700 BC to 2000 AD)
	• Basics of foundation and excarvation law / engineering law (the participants in the case law of geotechnical law case studies)
	Legal aspects of technical regulations in civil engineering (with case studies)
	• The civil engineering contract (including checklists for the special civil engineering contract design and execution)
	• The liability of the planner and entrepreneur in civil engineering (practical examples, jurisprudence and law, inter alia, to the
	Ordinance on Combatants, liability for defects and traffic safety obligations, construction law and insurance questions)
	• The ground / foundation risk and the systemic risk (also in the European context)
	• The total debt in (low) building law (based on practice-oriented case constellations)
	• The (construction) conflict, the dispute avoidance models and the construction process (practice-oriented presentation)
Literature	Folienskript (in der Vorlesung erhältlich)
	weitere Literatur:
	Englert, Grauvogel und Maurer: Handbuch des Baugrund- und Tiefbaurechts. Werner-Verlag

Course L1906: Service Contr	urse L1906: Service Contract and Procurement Law	
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Günther Schalk, Prof. Jürgen Grabe	
Language	DE	
Cycle	WiSe	
Content		
Literature		

Module M1716: Subsu	Irface Processes				
Courses					
<b>Fitle</b>		Тур	Hrs/wk	СР	
Modeling of Subsurface Processes (	L2731)	Recitation Section (small)	3	3	
Subsurface Solute Transport (L272)		Lecture	2	2	
Subsurface Solute Transport (L272)		Recitation Section (large)	1	1	
Module Responsible					
Admission Requirements	None				
Recommended Previous	Basic Mathematics, Hydrology				
Knowledge					
Educational Objectives	After taking part successfully, students have	reached the following learning results			
Professional Competence					
Knowledge	Upon completion of this module, the stude	nts will understand the mechanisms controlling	solute transpor	t in soil and natu	
	porous media and will be able to work with th	ne equations that govern the fate and transport of	of solutes in poro	us media. Analyti	
	numerical and experimental tools and technic	ques will be used in this module.			
Skills In addition to the physical insights, the students will be exposed to analytical, experimental and numerical tools a		als and technique			
38///3	this module. This provides them with an excellent opportunity to improve their skills on multiple fronts which will be useful in the				
	future career.	enerit opportunity to improve their skins on mate	pie nones which	will be useful in th	
Personal Competence					
	Teamwork & problem solving				
Autonomy	Teamwork & problem solving The students will be involved in writing individual reports and presentation. This will contribute to the students' ability a				
Autonomy	willingness to work independently and respor			students ability a	
Workload in Hours	Independent Study Time 96, Study Time in Le	•			
Credit points					
Course achievement					
Examination	Subject theoretical and practical work				
Examination duration and					
scale					
Assignment for the	Civil Engineering: Specialisation Structural En	naineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical				
	Civil Engineering: Specialisation Coastal Engi				
	Civil Engineering: Specialisation Water and Tr				
		nental Process Engineering: Elective Compulsory			
	Process Engineering: Specialisation Process E				
	Water and Environmental Engineering: Specia				
	Water and Environmental Engineering: Specia	alisation Environment: Elective Compulsory			

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

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

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

Courses	
<b>Title</b> Adaptation to climate change in hy	Typ     Hrs/wk     CP       draulic engineering (L2291)     Project-/problem-based Learning     4     6
Module Responsible	Prof. Peter Fröhle
Admission Requirements	None
Recommended Previous Knowledge	<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 Skills	<ul> <li>Climate protection and climate adaptation</li> <li>Insights into climate change and its regional characteristics - fundamentals, climate modelling / climate models</li> <li>Impacts of climate change on the components of the regional hydrological cycle</li> <li>Fundamentals of analysis of climate data</li> <li>Consequences of the impact of the climate change</li> <li>Measures for climate adaptation</li> <li>Assessment, prioritization and communication of adaptation measures</li> <li>Fundamentals of the analysis of hydrometeorological and hydrological data</li> </ul>
<b>Personal Competence</b> <i>Social Competence</i> <i>Autonomy</i>	<ul> <li>Working in heterogenous groups</li> <li>Working with different scientific / non-scientific disciplines</li> <li>Self reflection</li> <li>Application oriented use of knowledge and skills</li> </ul>
	Autonomous work on complex tasks
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
scale	Preparation of a written report and a presentation of a complex task. Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
Following Curricula	
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory
	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsory
	Water and Environmental Engineering: Specialisation Water: Elective Compulsory

Course L2291: Adaptation to	o climate change in hydraulic engineering
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	<ul> <li>Climate protection and climate adaptation</li> <li>Findings on climate change and its regional characteristics: fundamentals of climate change, climate modelling / climate models</li> <li>Impacts of climate change on the components of the regional hydrological cycle(climate science view)</li> <li>Fundamentals of the analysis of climate data</li> <li>Concequences of the impacts of climate change (ingenieering science view)</li> <li>Measures for climate change adaptation</li> <li>Assessment, prioritization and communication of measures</li> <li>Fundamentals of analysis of hydrometeorological and hydrological data</li> </ul>
Literature	Bereitgestellte eLearning Plattform

Courses				
Title Scientific Working in Computationa	Engineering (12764)	<b>Typ</b> Project-/problem-based Learning	Hrs/wk 4	<b>CP</b> 6
Module Responsible		Project-/problem-based Learning	4	0
	None			
		interest in topics related to computing in civil enginee	aring	
Knowledge	basic knowledge in sciencific writing. String	interest in topics related to computing in twi engine	sing.	
5	After taking part successfully, students hav	e reached the following learning results		
Professional Competence	······			
Skills	course instructors and in collaboration with each other, the students will also learn to understand the complex process of scient thinking, being able to accurately plan, implement and analyze scientific projects, such as prospective master theses. A prowill be conducted throughout the semester, which will contribute to the grade. Since scientific writing is of particular importance this course, a scientific paper will be developed based, which is a prerequisite for the final examination. The paper will be write based on the project conducted within this course. Project meetings in small groups, presentations, and critical discussion scientific publications are further key activities.			
Personal Competence Social Competence				
Autonomy				
,	Independent Study Time 124, Study Time i	n Lecture 56		
Credit points				
Course achievement				
Examination	Written elaboration			
Examination duration and	10 pages of work with 15-minute oral prese	entation		
scale	'			
Assignment for the	Civil Engineering: Specialisation Water and	Traffic: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnic	cal Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal En	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Structural			

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

Courses				
Title		Тур	Hrs/wk	СР
Sustainable Nature-based Coastal	Protection in a Changing Climate (SeaPiaC) (L2926)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge	Hydraulic Engineering			
	<ul> <li>Hydromechanics, Hydraulics</li> <li>Fundamentals of Coastal Engineering, Coastal- a</li> </ul>	nd Flood Protection		
	<ul> <li>Fundamentals of Coastal Engineering, Coastal- a</li> </ul>	In Flood Flotection		
Educational Objectives	After taking part successfully, students have reached t	ne following learning results		
Professional Competence				
Knowledge	- Climate and Climate Change			
	Climate and Climate Change     Constant Impacts of Climate Change on Wind Dec	ime and Water Cycle		
	<ul> <li>General Impacts of Climate Change on Wind Reg</li> <li>Consequences of Climate Change for Coastal Pro</li> </ul>			
	Coastal Protection in Taiwan and Germany			
	<ul> <li>Fundamentals of Climate Adaptation</li> </ul>			
	Nature-based Solutions (NBS) for Coastal Protect	ion		
Skills	<ul> <li>Critical thinking: analysis of processes and relati</li> </ul>	ons, assessment of needs for action		
	<ul> <li>Creative thinking: development of adaptation str</li> </ul>			
	<ul> <li>Practical thinking: inclusion of restrictions, app</li> </ul>		ods, numeric	al models, plannir
	methods			
	<ul> <li>Consideration of complex tasks</li> </ul>			
Personal Competence				
Social Competence	Working in heterogenous groups			
	Working in international groups			
	Working with different scientific / non-scientific of	isciplines		
	Self reflection			
Autonomy	<ul> <li>Application oriented use of knowledge and skills</li> </ul>			
	<ul> <li>Autonomous work on complex tasks</li> </ul>			
Westleed in Herrie	ladan and ant Chudu Time 124. Chudu Time in Lasture F			
Credit points	Independent Study Time 124, Study Time in Lecture 56			
Course achievement				
	Written elaboration			
	Preparation of a written report on a complex task with	a procentation and subsequent discussion	on The work	on the complex to
	happens in the course of the lecture.	a presentation and subsequent discussion	JII. THE WORK	on the complex ta
	Civil Engineering: Specialisation Coastal Engineering: E	ective Compulsory		
Following Curricula				
. eenning carricula	Civil Engineering: Specialisation Structural Engineering			
	Civil Engineering: Specialisation Water and Traffic: Elec			
	Water and Environmental Engineering: Specialisation C			
	Water and Environmental Engineering: Specialisation E			
	water and Environmental Engineering. Specialisation E			

Course L2926: Sustainable N	ature-based Coastal Protection in a Changing Climate (SeaPiaC)	
Тур	ect-/problem-based Learning	
Hrs/wk	4	
СР	6	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Prof. Peter Fröhle	
Language	EN	
Cycle	WiSe	
Content	<ul> <li>Climate and Climate Change</li> <li>General Impacts of Climate Change on Wind Regime and Water Cycle</li> <li>Consequences of Climate Change for Coastal Processes</li> <li>Coastal Protection in Taiwan and Germany</li> <li>Fundamentals of Climate Adaptation</li> <li>Nature-Based Solutions (NBS) for Coastal Protection</li> </ul>	
Literature	Materials provided on eLearning Platform (HOOU Platform)	

Courses				
Title		Тур	Hrs/wk	СР
Modern discretization methods in s	tructural mechanics (L3043)	Lecture	2	3
Modern discretization methods in s	tructural mechanics (L3044)	Recitation Section (small)	2	3
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous Knowledge	<ul><li>Finite Element Methods</li><li>Flächentragwerke</li></ul>			
Educational Objectives	After taking part successfully, students have	ve reached the following learning results		
Professional Competence				
Knowledge	After successful completion of this module mechanics.	e, students can express the basic aspects of moder	rn discretization r	nethods in structu
Skills	After successful completion of this module, the students will be able to use and further improve modern discretization methods for problems in structural mechanics.			
Personal Competence				
Social Competence	Students can			
	<ul> <li>participate in subject-specific and in</li> </ul>	terdisciplinary discussions,		
	<ul> <li>defend their own work results in from</li> </ul>	nt of others		
	<ul> <li>promote the scientific development</li> </ul>	of colleagues		
	<ul> <li>Furthermore, they can give and acc</li> </ul>	ept professional constructive criticism		
Autonomy	• •	e subject area from given and other sources and a cess for problems in the area of modern discretizat		bblems. Furthermo
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
-	Civil Engineering: Specialisation Coastal Er			
Following Curricula	Civil Engineering: Specialisation Geotechni			
	Civil Engineering: Specialisation Structural	Engineering: Elective Compulsory		

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

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

	<b>Typ</b> Lecture Recitation Section (small)	Hrs/wk	<b>СР</b> 3
	Lecture	2	з
	Recitation Section (small)		5
		2	3
dents have reached the	following learning results		
s module, students can e	express the basic aspects of modelli	ng of structures v	with finite element
his module, the student	s will be able to model structures	with finite elem	ents and to analy
fic and interdisciplinary	discussions,		
ults in front of others			
elopment of colleagues			
e and accept professiona	l constructive criticism		
dge of the subject area f	rom given and other sources and ar	only it to new pro	blems Furthermo
	-		
		<u> </u>	
idy Time in Lecture 56			
			in as (Tail )Trague
	-		
		intentation unu	Interpretation
Coastal Engineering: Elec	tive Compulsory		
	his module, students can e this module, the student mputational methods. ecific and interdisciplinary o sults in front of others velopment of colleagues ve and accept professiona ledge of the subject area f olution process for problem tudy Time in Lecture 56 Descrip theoretical andBearbe work mit e Ergebr	this module, the students will be able to model structures mputational methods. ccific and interdisciplinary discussions, sults in front of others velopment of colleagues ve and accept professional constructive criticism ledge of the subject area from given and other sources and ar polution process for problems in the area of finite element mode tudy Time in Lecture 56 Description theoretical andBearbeitung einer Finite-Elemente-Modelling	his module, students can express the basic aspects of modelling of structures with this module, the students will be able to model structures with finite elem mputational methods. ecific and interdisciplinary discussions, sults in front of others velopment of colleagues ve and accept professional constructive criticism ledge of the subject area from given and other sources and apply it to new pro plution process for problems in the area of finite element modelling of structure tudy Time in Lecture 56 Description theoretical andBearbeitung einer Finite-Elemente-Modellierungsaufgabe e work mit einer FE-Software inklusive Dokumentation und Ergebnisse

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

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

Module M1845: Thin-				
Module M1845: Inin-	walled structures			
Courses				
Title		Тур	Hrs/wk	СР
Thin-walled structures (L1199)		Lecture	2	3
Thin-walled structures (L3045)		Recitation Section (large)	2	3
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge	Structural Analysis I			
	<ul> <li>Structural Analysis II</li> <li>Finite Element Methods</li> </ul>			
	Finite Element Methods			
Educational Objectives	After taking part successfully, students have reac	hed the following learning results		
Professional Competence				
Knowledge	After successful completion of this module, the	students can express the basic aspects of	the load-carryin	g behaviour of thin
	walled structures.			
CL 111		and the second		
SKIIIS	After successful completion of this module, the s		g benaviour of th	nin-walled structure
	using appropriate analytical and coputational met	noas.		
Personal Competence				
Social Competence	Students can			
	<ul> <li>participate in subject-specific and interdisci</li> </ul>			
	defend their own work results in front of otl			
	<ul> <li>promote the scientific development of college</li> </ul>			
	<ul> <li>Furthermore, they can give and accept prot</li> </ul>	tessional constructive criticism		
Autonomy	Students are able to gain knowledge of the subject	ct area from given and other sources and a	oply it to new pro	blems. Furthermore
,	they are able to structure the solution process for			
	Independent Study Time 124, Study Time in Lectu	ire 56		
Credit points				
Course achievement	None			
Examination				
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineeri	ng: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Eng	ineering: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engine			
	Civil Engineering: Specialisation Coastal Engineeri			
	Civil Engineering: Specialisation Geotechnical Eng			
	Civil Engineering: Specialisation Structural Engine	• • •		
	Theoretical Mechanical Engineering: Specialisation	n Simulation Technology: Elective Compulso	ry	

Тур	Lecture
Hrs/wk	
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
	Prof. Bastian Oesterle
Language	DE
Cycle	SoSe
Content	Plates loaded in-plane
	Governing equations (equilibrium, kinematics, constitutive law)
	Differential equation
	Airy stress function
	Plane stress / plane strain
	Structural behaviour of plates loaded in-plane
	<ul> <li>finite elements for plates loaded in-plane, modelling apsects, interpretation and critical assessment of results</li> </ul>
	Plates in bending
	Governing equations (equilibrium, kinematics, constitutive law)
	Differential equation
	Navier solution / Fourier series expansion
	Approximation procedures
	Circular and rectangular plates
	Structural behaviour of plates in bending
	<ul> <li>finite elements for plates in bending, modelling apsects, interpretation and critical assessment of results</li> </ul>
	Shells
	Phenomenona of the structural behaviour of shells
	Membrane and bending theory
	<ul> <li>Equilibrium equations of shells of revolution</li> <li>Stress resultants and deformations of the spherical shell, the half spherical shell, and the cylindrical shell</li> </ul>
	<ul> <li>Stress resultants and deformations of the spherical shell, the half spherical shell, and the cylindrical shell</li> <li>finite elements for shells</li> </ul>
	Stability problems (overview)
	Plate buckling
	Shell buckling
Literature	Vorlesungsmanuskript
	<ul> <li>Vorresungsmanuskript</li> <li>Basar, Y.: Krätzig, W.B. (1985): Mechanik der Flächentragwerke. Vieweg-Verlag, Braunschweig, Wiesbaden</li> </ul>
	<ul> <li>Basar, T., Kratzig, W.B. (1983). Mechanik der Pachentagwerke. Neweg-verlag, Bradischweig, Wiesbadert</li> <li>Girkmann, K. (1963): Flächentragwerke, Springer Verlag, Wien, 1963, unveränderter Nachdruck 1986</li> </ul>
	<ul> <li>Zienkiewicz, O.C. (1977): The Finite Element Method in Enginieering Science. McGraw-Hill, London</li> </ul>
	Elementer, olor (1977). The time element rection in Engineering Science, recordwrini, London

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

## **Specialization Structural Engineering**

## Module M0699: Geotechnics III Courses Title Тур Hrs/wk СР Numerical Methods in Geotechnics (L0375) Lecture 3 3 2 2 Advanced Foundation Engineering (L0497) Lecture Advanced Foundation Engineering (L0498) Recitation Section (large) 1 1 Module Responsible Prof. Jürgen Grabe Admission Requirements None **Recommended Previous** Knowledge Educational Objectives After taking part successfully, students have reached the following learning results **Professional Competence** Knowledge Skills Personal Competence Social Competence Autonomy Workload in Hours Independent Study Time 96, Study Time in Lecture 84 Credit points 6 Course achievement None Examination Written exam Examination duration and 120 min scale Assignment for the Civil Engineering: Specialisation Structural Engineering: Compulsory Following Curricula Civil Engineering: Specialisation Geotechnical Engineering: Compulsory Civil Engineering: Specialisation Coastal Engineering: Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory

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

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

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

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

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

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

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

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

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

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

Madula MOOCO. Charl	and Commercity Structures			
Module M0963: Steel	and Composite Structures			
Courses				
itle		Тур	Hrs/wk	СР
Steel and Composite Structures (L1	204)	Lecture	2	2
Steel and Composite Structures (L1		Recitation Section (large)	2	2
Steel Bridges (L1097)		Lecture	2	2
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
<b>Recommended Previous</b>	Basics of steel construction (i.e. Steel Structures I and II, BUBC)			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results		
Professional Competence				
Knowledge	After successful completition, students can			
	describe the phenomenon of local buckling			
	explain warping torsion			
	<ul> <li>illustrate the behaviour of composite structures</li> </ul>			
	<ul> <li>specify the principles in design of composite structures</li> </ul>			
	<ul> <li>sketch the contructions of steel and composite bridges</li> </ul>			
Skills	After successful participation students are able to			
	check stiffened and unstiffened plated structures			
	<ul> <li>recognize and verify warping tosion in strucures</li> </ul>			
	design composite structures			
	<ul> <li>design bridges and o perform the detailing</li> </ul>			
Personal Competence				
Social Competence				
Autonomy				
,	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Compu	Isory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elec	tive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective C	Compulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Com	npulsory		
	International Management and Engineering: Specialisation II. Ci	vil Engineering: Elective Com	oulsory	

Course L1204: Steel and Con	nposite Structures	
Тур	Lecture	
Hrs/wk	2	
CP	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>	
	Petersen, C.: Stahlbau, 4.Auflage 2013, Springer-Vieweg Verlag Minnert, J. Wagenknecht, G.: Verbundbau-Praxis - Berechnung und Konstruktion nach Eurocode 4, 2.Auflage 2013, Bauwerk Beuth Verlag	

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

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

Module M0511: Electi	rical Energy from Solar Radia	ation and Wind Power		
Courses				
Title		Tura	Han buck	CD.
Sustainability Management (L0007		<b>Typ</b> Lecture	Hrs/wk 2	<b>CP</b> 1
Hydro Power Use (L0013)		Lecture	1	1
Wind Turbine Plants (L0011)		Lecture	2	3
Wind Energy Use - Focus Offshore	L0012)	Lecture	1	1
Module Responsible	Dr. Isabel Höfer			
Admission Requirements	None			
<b>Recommended Previous</b>	Module: Technical Thermodynamics I,			
Knowledge				
	Module: Technical Thermodynamics II,			
	Module: Fundamentals of Fluid Mechanics	S		
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
	By ending this module students can exp	plain in detail knowledge of wind turbines wi	th a particular focus of	f wind energy use
		ment these aspects in consideration of current		
	to describe fundamentally the use of wat	ter power to generate electricity. The students	reproduce and explain	the basic procedu
	in the implementation of renewable ener	gy projects in countries outside Europe.		
	•	opics within the seminar of the module, stud		derstanding and t
	application of the theoretical background	and are thus able to transfer what they have	learned in practice.	
Skills	Students are able to apply the acquire	d theoretical foundations on exemplary wate	r or wind power system	ns and evaluate a
		ships in the context of dimensioning and oper		
	compare critically the special procedure for the implementation of renewable energy projects in countries outside E			
	in principle applied approach in Europe a	nd can apply this procedure on exemplary the	oretical projects.	
Personal Competence				
Social Competence	Students can discuss scientific tasks sub	jet-specificly and multidisciplinary within a ser	minar.	
Autonomy	Students can independently exploit sour	rces in the context of the emphasis of the le	ecture material to clear	the contents of t
	lecture and to acquire the particular know	wledge about the subject area.		
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	2.5 hours written exam + written elabora	ation (incl. presentation) in sustainability mana	igement	
scale			-	
Assignment for the	Civil Engineering: Specialisation Structura	al Engineering: Elective Compulsory		
Following Curricula				
_	Civil Engineering: Specialisation Coastal I	Engineering: Elective Compulsory		
		ng: Specialisation II. Energy and Environmenta	al Engineering: Elective	Compulsory
	• •	ng: Specialisation II. Renewable Energy: Electi		
	Product Development, Materials and Proc	duction: Specialisation Product Development: E	Elective Compulsory	
	Product Development, Materials and Proc	duction: Specialisation Production: Elective Cor	mpulsory	
	Product Development, Materials and Proc	duction: Specialisation Materials: Elective Com	pulsory	
	Renewable Energies: Core Qualification:	Compulsory		
	Theoretical Mechanical Engineering: Spec	cialisation Energy Systems: Elective Compulso	ry	
	Process Engineering: Specialisation Envir	onmental Process Engineering: Elective Comp	ulsory	
	Water and Environmental Engineering: S	pecialisation Environment: Compulsory		
	Water and Environmental Engineering: S			

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

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Digital Building (L1908)		Lecture	2	2
Lean Construction (L1910)		Lecture	2	2
System Dynamics (L1909)		Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Tim	e in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coasta	I Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geoted	chnical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Structu	ural Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Water	and Traffic Floctive Compulsory		

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Design of Prestressed Structures a	nd Concreet Bridges (L0603)	Lecture	3	4
Design of Prestressed Structures a	nd Concreet Bridges (L0604)	Recitation Section (large)	2	2
Module Responsible	Prof. Günter Rombach			
Admission Requirements	None			
<b>Recommended Previous</b>	Detailed knowledge on the design of cond	crete structures.		
Knowledge	Modules: Reinforced Concrete Structures I+II, Structural Analysis I+II, Mechanics I+II, Concrete Structures			
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	dge The students know the main bridge types, their applications and the various loads. They can explain the basic des			asic design metho
	They can explain the design of a prestres	sed 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.		r students	
Autonomy	The students are able to design a prestre	ssed concrete bridge and discuss the problems and	results with othe	r students.
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 minutes			
scale				
Assignment for the	Civil Engineering: Specialisation Structura	I Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechr	nical Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal E	ngineering: Elective Compulsory		
	International Management and Engineering	ng: Specialisation II. Civil Engineering: Elective Com	nulcon	

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

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

Courses					
Title		Тур	Hrs/wk	СР	
Boundary Element Methods (L0523	)	Lecture	2	3	
Boundary Element Methods (L0524		Recitation Section (large)	2	3	
Module Responsible	Prof. Otto von Estorff				
Admission Requirements	None				
<b>Recommended Previous</b>	Mechanics I (Statics, Mechanics of Mate	ials) and Mechanics II (Hydrostatics, Kinematics, I	ynamics)		
Knowledge	Mathematics I, II, III (in particular differe	ntial equations)			
	After taking part successfully, students	any conclude the following learning regults			
	After taking part successfully, students	nave reached the following learning results			
Professional Competence	<b>-</b>				
Knowledge	overview of the theoretical and methodi	ledge regarding the derivation of the boundary e	element method and	d are able to give a	
<i>CL 11</i>	<b>-</b>	and the second			
SKIIIS		engineering problems by formulating suitable	e boundary eleme	nts, assembling ti	
	corresponding system matrices, and sol	ving the resulting system of equations.			
Personal Competence					
Social Competence	Students can work in small groups on sp	ecific problems to arrive at joint solutions.			
Autonomy	The students are able to independently solve challenging computational problems and develop own boundary element routines				
	Problems can be identified and the results are critically scrutinized.				
Workload in Hours	Independent Study Time 124, Study Tim	e in Lecture 56			
Credit points	6				
Course achievement	Compulsory Bonus Form	Description			
	No 20 % Midterm				
Examination					
Examination duration and	90 min				
scale					
-	Civil Engineering: Specialisation Structu				
Following Curricula	Civil Engineering: Specialisation Geotecl Civil Engineering: Specialisation Coastal				
	Energy Systems: Core Qualification: Elec	• • • •			
		nt: Specialisation Product Development and Produ	ction: Elective Com	oulsory	
	Mechatronics: Specialisation System De		cion. Licenve comp	Julion y	
		duction: Core Qualification: Elective Compulsory			
		ngineering Science: Elective Compulsory			
		5 5			

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

Course L0524: Boundary Eler	urse 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 M0756: Soil M	lechanics and	-Dynamics				
Courses						
Title				Тур	Hrs/wk	СР
Soil Mechanics - Selected Topics (L	)374)			Lecture	2 3	2
Soil Dynamics (L0452) Experimental Researches in Geoteo	bnics (10706)			Lecture Practical Course	1	2
Module Responsible				Thecheal Course	Ŧ	L
	None					
Recommended Previous		ics I-III. Mechanics I-II. G	eotechnics I			
Knowledge		cory course, (Applied stru				
Educational Objectives	After taking part suc	ccessfully, students have	e reached the follow	ving learning results		
Professional Competence						
Knowledge	After the successful	completion of the modu	le the students sho	ould be able to:		
	e to dorivo and	to apply the basis equa	tion of a cimalo ma	aa aacillatar		
		to apply the basic equal			start the relevant par	amotors
				namic excitation and to d		
				nine soil dynamic charact	eristics and to evaluat	të them,
		chine foundations to dyn				
		hocks to perform vibration				
		hocks in term to their eff	fect on people and	buildings,		
	<ul> <li>to evaluate p</li> </ul>	ossibilities of isolation,				
	<ul> <li>to understand</li> </ul>	I mechanisms that cause	e earthquakes and	evaluate earthquake in te	rm of their magnitude	e and intensity,
	<ul> <li>to know meth</li> </ul>	ods to determine axial p	oile capacity, integr	ity and the dynamic bedd	ing modulus,	
	<ul> <li>to know the mechanisms that lead to a deformation accumulation due to cyclic loading and to estimate these defor mathematically,</li> </ul>					e these deformati
	<ul> <li>to distinguish</li> </ul>	the area of application	of the method of el	astodynamics and plastoc	lynamics,	
	<ul> <li>to detect the</li> </ul>	undrained shear strengt	h as a function of a	number of state variable	S,	
	<ul> <li>to capture the</li> </ul>	e visous behaviour of co	hesive soils and to	consider the effects of cr	eep and rate-depend	ent shear strengtl
	calculations,					
	<ul> <li>to consider th</li> </ul>	ne impact of the partly sa	aturated of a seepa	ge and shear strength.		
Skills						
Personal Competence						
Social Competence						
Autonomy						
		Time 96, Study Time in L	Lecture 84			
Credit points	Compulsory Bonus	Form	Description			
Course achievement	Yes 15 %	Subject theoretical practical work				
Examination	Written exam					
Examination duration and scale	150 min					
Assignment for the	Civil Engineering: Sr	pecialisation Structural E	naineerina: Electiv	e Compulsory		
Following Curricula		pecialisation Geotechnica				
ronowing curricula	Civil Lingineering: 50		ai Lhuineetiitu. Cott			

Course L0374: Soil Mechanic	s - Selected Topics	
Тур	Lecture	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Dr. Hans Mathäus Stanford	
Language	DE	
Cycle	SoSe	
Content	selected topis:	
	- continuum mechanis	
	- constitutive modelling	
	- time and rate dependend material behavior of soils	
	- cyclic loading	
	- undrained conditions	
Literature	Kolymbas D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. Springer Verlag	

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

Course L0706: Experimental	Researches in Geotechnics
Тур	Practical Course
Hrs/wk	1
СР	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Dr. Marius Milatz
Language	DE
Cycle	SoSe
Content	<ul> <li>The students are supposed to:</li> <li>become acquainted with geotechnical model tests, field tests and laboratory tests as well as corresponding measurement techniques. These compromise amongst others inclinometer measurements and geophone measurements as well as high-grade laboratory tests on the stress-strain relationship of soil specimens, e. g. triaxial tests, simple shear tests and resonant column tests.</li> <li>gain insight into current soil mechanical research.</li> <li>plan, coordinate, perform and evaluate soil mechanical tests in a team.</li> <li>discuss, reflect, review and present the obtained results in a group.</li> </ul> An important learning target is the introduction to scientific work for students who plan a scientific career, and for those who will work in practice with the responsibility to order corresponding tests and evaluate the results. The practical laboratory work is based on annualy changing problems, which are however related to the experience and results of the preceding year's course group.
Literature	- Grabe, J. (2004): Bodenmechanik und Grundbau, Band 3 der Veröffentlichungsreihe des Instituts für Geotechnik und Baubetrieb, Technische Universität Hamburg-Harburg.
	<ul> <li>Kolymbas, D. (2007): Geotechnik - Bodenmechanik, Grundbau und Tunnelbau. 2., korrigierte und ergänzte Auflage, Springer Verlag.</li> <li>Normen zu geotechnischen Versuchsgeräten und Versuchsverfahren: <ul> <li>DIN 18135:2012-04: Baugrund, Untersuchung von Bodenproben -</li> <li>Eindimensionaler Kompressionsversuch, Deutsches Institut für</li> <li>Normung, e. V.</li> </ul> </li> <li>DIN 18137-2:2011-04: Baugrund, Untersuchung von Bodenproben -</li> <li>Bestimmung der Scherfestigkeit - Teil 2: Triaxialversuch, Deutsches Institut für Normung e. V.</li> </ul>

Courses					
Title		Тур	Hrs/wk	СР	
Groundwater Modeling using Modflow (L0543)		Lecture	1	1	
Groundwater Modeling using Modflow (L0544) Modeling of Water Supply and Sewer Network (L0875)		Recitation Section (small) Project-/problem-based Learning	2 2	2 3	
Module Responsible			2	5	
Admission Requirements	None				
Recommended Previous					
Knowledge					
	groundwater hydraulics and transport of substances				
	Pipe Systems				
	Knowledge on urban water infrastructures, in	n particular drinking water systemsand u	urban drainad	o systems includi	
	special structures	n particular armking water systemsana e	indun urunnug	e systems menual	
	Hydraulics of drinking water supply systems an	d sewer systems			
	Basic knowledge on water management				
Educational Objectives	After taking part successfully, students have reached	the following learning results			
Professional Competence	5,	5			
Knowledge	The students are able to describe the modelling of gro	oundwater flow and transport as well as urb	oan water infra	astructures. They o	
	carry out systems analyses and can detect technical and conceptual weak points within the systems in case studies. Besides the				
	are able to analyse interdependencies of hydraulic and toxic phenomena in soil and water.				
Skills	The students are able to construct and apply scientific groundwater models indipendently. They can work on different scenario				
	and can compare or assess different solutions for existing problems by application of selected software products. The students a able to use different software solutions (e.g. EPANET, EPA-SWMM).				
	able to use different solutions (e.g. EPANET,	EPA-SWMM).			
Personal Competence	Wird night vormittalt				
Sucial Competence	Wird nicht vermittelt.				
Autonomy	Wird nicht vermittelt.				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 7	70			
Credit points	6				
Course achievement	None				
Examination	Oral exam				
	20 min				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Engineerin	5 1 5			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: 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				
	Water and Environmental Engineering: Specialisation	Cities: Elective Compulsory			

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

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

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

Courses					
Courses Fitle			Une (colo	СР	
Noise Protection (L1109)		<b>Typ</b> Lecture	Hrs/wk 2	2	
Jrban Infrastructures (L0874)		Project-/problem-based Learning	2	4	
Module Responsible	Dr. Dorothea Rechtenbach				
Admission Requirements	None				
<b>Recommended Previous</b>					
Knowledge	Knowledge on Urban planning				
-	<ul> <li>Knowledge on measures for climate protection</li> </ul>				
	General knowledge of scientific writing/working				
Educational Objectives	After taking part successfully, students have reached the follow	ing learning results			
Professional Competence					
Knowledge	Students can describe urban development corridors as well as	current and future urban environr	mental probler	ns. They are able	
	explain the causes of environmental problems (like noise).				
	Students can specify applications for various technical innovati	ons and explain why these contri	bute to the im	provement of urb	
	life. They can, for example, derive and discuss measures for effective noise abatement.				
Skills	s Students are able to develop specific solutions for correcting existing or future environment-related problems of urb				
JKIIIS	development. They can define a range of conceptual and technical solutions for environmental problems for different developme				
	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 together in international groups.				
4					
Autonomy	Students are able to organize their work flow to prepare them		ributions to tr	ie discussions. II	
	can acquire appropriate knowledge by making enquiries indepe	ndentiy.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56				
Credit points	6				
Course achievement	None				
Examination	Written elaboration				
Examination duration and	Written Report plus oral Presentation				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective	e Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elec	tive Compulsory			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory				
	Civil Engineering: Specialisation Water and Traffic: Elective Con	npulsory			
	Environmental Engineering: Core Qualification: Elective Computed States Computed States Computed States State	sory			
	Joint European Master in Environmental Studies - Cities and Sus	tainability: Core Qualification: Cor	mpulsory		
	Logistics, Infrastructure and Mobility: Specialisation Infrastructu		ory		
	Water and Environmental Engineering: Specialisation Environmental	ent: Elective Compulsory			
	Water and Environmental Engineering: Specialisation Cities: Co				

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

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

Courses				
Title		Тур	Hrs/wk	СР
Coastal- and Flood Protection (L0808)		Lecture	2	3
Coastal- and Flood Protection (L14)	.5)	Project-/problem-based Learning	1	1
Maintennance and Defence of Floor	d Protection Structures (L1411)	Lecture	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
<b>Recommended Previous</b>	Coastal Engineering I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	The students have the capability to define and explain in detail the important aspects of erosion protection and flood protecti			
	and are able to apply the aspects to practical coastal protection problems. They are able to design and dimension impo		dimension import	
	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 protec			
	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 desig			
	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	The duration of the examination is 130 min. The examination includes tasks with respect to the general understanding of t			
scale	lecture contents and calculations tasks.			
Assignment for the	Civil Engineering: Specialisation Structural Engineeri	ng: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine	eering: Elective Compulsory		

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

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

Course L1411: Maintennance	and Defence of Flood Protection Structures
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Dr. Olaf Müller
Language	DE
Cycle	SoSe
Content	<ul> <li>Dike protection</li> <li>Maintennance of flood protection measures</li> </ul>
Literature	Vorlesungsumdruck

Courses				
Title		Тур	Hrs/wk	СР
Harbour Engineering (L0809)		Lecture	2	2
Harbour Engineering (L1414)		Project-/problem-based Learning	1	2
Port Planning and Port Construction	(L0378)	Lecture	2	2
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
<b>Recommended Previous</b>	Basics of coastal engineering			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the follow	ving learning results		
Professional Competence				
Knowledge	The students are able to define in details and to choose design approaches for the functional design of a port and apply ther			
	design tasks. They can design the fundamental elements of a port.			
<i></i>	The students are able to select and apply appropriate approaches for the functional design of ports.			
SKIIIS	The students are able to select and apply appropriate approach	nes for the functional design of po	rts.	
Personal Competence				
Social Competence	The students are able to deploy their gained knowledge in a	oplied problems such as the funct	tional design	of ports. Addition
	they will be able to work in team with engineers of other discip	lines.		
Autonomy	The students will be able to independently extend their knowle	dge and apply it to new problems		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 150 min. The examination	n includes tasks with respect to	the general u	understanding of
	lecture contents and calculations tasks.		5	5
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Electiv	e Compulsory		
-	Civil Engineering: Specialisation Geotechnical Engineering: Ele			
-	Civil Engineering: Specialisation Coastal Engineering: Compuls			
	Civil Engineering: Specialisation Water and Traffic: Elective Co	•		
	International Management and Engineering: Specialisation II. C			

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

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

Hrs/wk 2 CP 2 Yorkload in Hours 1 Lecturer 1 Language 1	2 Independent Study Time 32, Study Time in Lecture 28
orkload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	
Language	Frank Feindt
	DE
Cycle	SoSe
Content	<ul> <li>Planning and implementation of major projects</li> <li>Market analysis and traffic relations</li> <li>Planning process and plan</li> <li>Port planning in urban neighborhood</li> <li>Development of the logistics center "Port of Hamburg" in the metropolis</li> <li>Quays and waterfront structure</li> <li>Special planning Law Harbor - securing of a flexible use of the port</li> <li>Dimensioning of quays</li> <li>Flood protection structures</li> <li>Port of Hamburg - Infrastructure and development</li> <li>Preparation of areas</li> <li>Scour formation in front of shore structures</li> </ul>

Courses				
Title		Тур	Hrs/wk	СР
Hydraulic Models (L0813)		Project-/problem-based Learning	1	1
Modelling of Waves (L0812)		Project-/problem-based Learning	1	1
Modelling of Flow in Rivers and Est	aries (L0810)	Lecture	3	4
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
<b>Recommended Previous</b>	Coastal Hydraulic Engineering I			
Knowledge				
Educational Objectives	After taking part successfully, students have reached the following learning results			
Professional Competence				
Knowledge	Students are able to define in detail the basic processes that are related to the modelling of flows in hydraulic engineering			
	Besides, they can describe the basic aspects of numerical modelling and actual numerical models for the simulation of flows a			
	waves.			
<i></i>				
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 te		able to work in tea	
	with others.			
Autonomy	The students will be able to independently extend their know	owledge and apply it to new problems		
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	The duration of the examination is 3 hours. The examin	ation includes tasks with respect to	the general u	Inderstanding of t
	lecture contents and calculations tasks.		5	5
	Civil Engineering: Specialisation Structural Engineering: Ele	ective Compulsory		
Assignment for the				
-	Civil Engineering: Specialisation Scretchical Engineering: Ere			

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Wastewater Systems - Collection, Tr	eatment and Reuse (L0934)	Lecture	2	2
Wastewater Systems - Collection, Tr		Recitation Section (large)	1	1
Advanced Wastewater Treatment (L	0357)	Lecture	2	2
Advanced Wastewater Treatment (L	nent (L0358) Recitation Section (large) 1 1			1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
<b>Recommended Previous</b>	Knowledge of wastewater management and	d the key processes involved in wastewater trea	ment.	
Knowledge				
Educational Objectives	After taking part successfully, students hav	ve reached the following learning results		
<b>Professional Competence</b>				
Knowledge	Students are able to outline key areas of the	he full range of treatment systems in waste wate	er management, as	well as their mut
	dependence for sustainable water protection	on. They can describe relevant economic, enviro	nmental and social	factors.
Ckille	Students are able to are design and evalu	in the available wastewater treatment process	and the scene of	f their application
SKIIIS		in the available wastewater treatment process	es and the scope t	or their application
	municipal and for some industrial treatmen	it plants.		
Personal Competence				
Social Competence	Social skills are not targeted in this module.			
Autonomy		subject and to organize their work flow indepe	ndently. They can	also present on th
	subject.			
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnic	cal Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal En	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and	Traffic: Compulsory		
	Bioprocess Engineering: Specialisation A - 0	General Bioprocess Engineering: Elective Compu	sory	
	Environmental Engineering: Specialisation	Water: Elective Compulsory		
	International Management and Engineering	g: Specialisation II. Process Engineering and Biote	chnology: Elective	Compulsory
	International Management and Engineering	g: Specialisation II. Energy and Environmental En	gineering: Elective	Compulsory
		nmental Process Engineering: Elective Compulso	У	
	Process Engineering: Specialisation Process			
	Water and Environmental Engineering: Spe			
	Water and Environmental Engineering: Spe	cialisation Environment: Elective Compulsory		

## Course L0934: Wastewater Systems - Collection, Treatment and Reuse

Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
Content	•Understanding the global situation with water and wastewater
	•Regional planning and decentralised systems
	•Overview on innovative approaches
	•In depth knowledge on advanced wastewater treatment options for different situations, for end-of-pipe and reuse
	•Mathematical Modelling of Nitrogen Removal
	•Exercises with calculations and design
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 S	rse L0943: Wastewater Systems - Collection, Treatment and Reuse	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Ralf Otterpohl	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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

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

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

Course L1066: City Planning	
Тур	Project-/problem-based Learning
Hrs/wk	4
CP	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Carsten Gertz
Language	DE
Cycle	SoSe
Content	"Principles of Urban Planning" deals with the determinants of urban development and their interactions. Topics include:
	<ul> <li>legal framework,</li> <li>instruments and methods of planning,</li> <li>functional requirements,</li> <li>stakeholders and actors</li> <li>basic design requirements</li> <li>different planning levels and</li> <li>historical contexts.</li> </ul> The objective of the course is for students to acquire a basic understanding of urban development problems and approaches for solving them. They will also be able to comprehend the process of urban planning. The course also covers the various functional and aesthetic requirements for designing streetscape as the most important elements of public space. The project work deals with a real life scenario and includes drawing up a development plan, an urban design concept, a building masterplan and a street redesign.
Literature	Albers, Gerd; Wekel, Julian (2009) Stadtplanung: Eine illustrierte Einführung. Primus Verlag. Darmstadt. Frick, Dieter (2008) Theorie des Städtebaus: Zur baulich-räumlichen Organisation von Stadt. Wasmuth-Verlag. Tübingen
	Jonas, Carsten (2009) Die Stadt und ihr Grundriss. Wasmuth-Verlag. Tübingen
	Kostof, Spiro; Castillo, Greg (1998) Die Anatomie der Stadt. Geschichte städtischer Strukturen. Campus-Verlag. Frankfurt/New York.

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Courses				
Title	Тур	)	Hrs/wk	СР
Construction Logistics (L1163)		ture	1	2
Construction Logistics (L1164)		itation Section (small)	1	2
Project Development and Management (L1161) Project Development and Management (L1162)		ture ject-/problem-based Learning	1	1
		ect-problem-based Learning	1	1
Module Responsible Admission Requirements	None			
Recommended Previous	none			
Knowledge	none			
	After taking part successfully, students have reached the following lo	orning results		
	After taking part successfully, students have reached the following le	arning results		
Professional Competence	Students con			
Knowledge	Students can			
	give definitions of the main terms of construction logistics and	project development and ma	anagement	
	<ul> <li>name advantages and disadvantages of internal or external co</li> </ul>	Instruction logistics		
	<ul> <li>explain characteristics of products, demand and production of</li> </ul>	construction objects and the	eir consequer	nces for construction
	specific supply chains			
	<ul> <li>differentiate constructions logistics from other logistics system</li> </ul>	IS		
Skills	Students can			
	<ul> <li>carry out project life cycle assessments</li> </ul>			
	<ul> <li>apply methods and instruments of construction logistics</li> </ul>			
	<ul> <li>apply methods and instruments of project development and m</li> </ul>	anagement		
	<ul> <li>apply methods and instruments of conflict management</li> </ul>			
	<ul> <li>design supply and waste removal concepts for a construction p</li> </ul>	project		
Personal Competence				
Social Competence	Students can			
	hold presentations in and for groups			
	<ul> <li>apply methods of conflict solving skills in group work and case</li> </ul>	studies		
Autonomy	Students can			
	solve problems by holistic, systemic and flow oriented thinking			
	<ul> <li>improve their creativity, negotiation skills, conflict and crises studies</li> </ul>	s solution skills by applying	methods of	moderation in ca
	studies			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Two written papers with presentations			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Com	ipulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective C	Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Compu	ilsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Compulso	ory		
	International Management and Engineering: Specialisation II. Civil Eng	gineering: Elective Compulso	ory	
	International Management and Engineering: Specialisation II. Logistic	s: Elective Compulsory		
	Logistics, Infrastructure and Mobility: Specialisation Production and Lo	ogistics: Elective Compulsory	/	
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and	d Mobility: Elective Compulso	ory	

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

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

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

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

Courses						
Title		Тур	Hrs/wk	СР		
Structural Dynamics (L1202)		Lecture	2	2		
Structural Dynamics (L1203)		Recitation Section (large)	2	2		
Fracture mechanics and fatigue in		Lecture	1	1		
Fracture mechanics and fatigue in	steel structures (L0565) Recitation Section (large) 1 1					
Module Responsible	Prof. Uwe Starossek					
Admission Requirements	None					
<b>Recommended Previous</b>	Knowledge of linear structural analysis	Knowledge of linear structural analysis of statically determinate and indeterminate structures; Mechanics I/II, Mathematics I/				
Knowledge	Differential equations I					
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results				
	After taking part successfully, students ha	ave reached the following learning results				
Professional Competence						
Knowledge		ule, the student can explain the basic aspects of o	lynamic effects o	on structures and t		
	respective methods.					
Skills		dule, the students will be able to predict the re-	sponse of materi	ial and structures		
	dynamics loading using the appropriate computational approaches and methods.					
Personal Competence						
Social Competence	Students can					
Social competence						
	<ul> <li>participate in subject-specific and i</li> </ul>	interdisciplinary discussions,				
	<ul> <li>defend their own work results in from the second sec</li></ul>	ont of others				
	<ul> <li>promote the scientific developmen</li> </ul>	t of colleagues				
	• Furthermore, they can give and ac	cept professional constructive criticism				
Autonomy	Students are able to gain knowledge of the	he subject area from given and other sources and a	pply it to new pr	oblems. Furthermo		
	they are able to structure the solution pro	ocess for problems in the area of Structural Analysis				
Workload in Hours	Independent Study Time 96, Study Time i	in Lecture 84				
Credit points						
Course achievement						
	Written exam					
Examination duration and	150 min					
scale						
Assignment for the	Civil Engineering: Specialisation Structura	al Engineering: Compulsory				
Following Curricula						
	Civil Engineering: Specialisation Coastal E					
	Civil Engineering: Specialisation Water an					
	ELVI ELULIEELIUV, SUEUAIISAUUT WALEE AL					
		ng: Specialisation II. Civil Engineering: Elective Com	nulcon			

Course L1202: Structural Dy	namics
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	SoSe
Content	<ul> <li>Single-degree-of-freedom systems: undamped and damped vibration, free vibration, forced vibrations due to harmonic, periodical or arbitrary loading, natural frequency, damping</li> <li>vibration isolation</li> <li>solution in the frequency-domain (Fourier transformation), solution in the time-domain</li> <li>multi-degree-of-freedom systems: continuous or discrete systems, modelling with finite elements, generalisation</li> <li>modal analysis</li> <li>power iteration according to v.Mises</li> <li>earthquake loading: seismological basics, response spectrum method</li> <li>wind-induced vibrations: engineering meteorology, aerodynamic, classification of excitation mechanisms</li> </ul>
Literature	Clough, R.W., Penzien, J.: Dynamics of Structures. 2. Aufl., McGraw-Hill, New York, 1993.

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

Тур	Lecture
Hrs/wk	
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Jürgen Priebe
Language	DE
Cycle	SoSe
Content	<ul> <li>basics of fatigue stress and fatigue resistance and determination of fatigue strength,</li> </ul>
	determination and use of S-N-curves and classification of notch effects,
	• set up of determination of fatigue strength under dynamic load using the accumulation formula by Palmgren-Miner,
	<ul> <li>set up of determination of fatigue strength in different examples,</li> </ul>
	<ul> <li>basics of construction and design regarding the problem of material fatigue,</li> </ul>
	<ul> <li>basics of linear elastic fracture mechanics under static and dynamic load,</li> </ul>
	determination of lifetime of steel construction based on linear elastic fracture mechanics in different examples.
Literature	Seeßelberg, C.; Kranbahnen - Bemessung und konstruktive Gestaltung; 3. Auflage; Bauwerk-Verlag; Berlin 2009
	Kuhlmann, Dürr, Günther; Kranbahnen und Betriebsfestigkeit; in Stahlbau Kalender 2003; Verlag Ernst & Sohn; Berlin 2003
	Deutscher Stahlbau-Verband (Hrsg.); Stahlbau Handbuch Band 1 Teil B; 3. Auflage; Stahlbau-Verlagsgesellschaft; Köln 1996
	Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993
	<ul> <li>DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsreg</li> <li>Bemessungsregeln f         ür den Hochbau; 1993</li> </ul>
	• DIN V ENV 1993-6: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 6: Kranbahnen; 2001
	• DIN-Fachbericht 126. Richtlinie zur Anwendung von DIN V ENV 1993-6; Nationales Anwendungsdokument (NAD); Berlin 200

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

## Module M0593: Building Materials and Building Preservation

Courses						
Title			Тур		Hrs/wk	СР
Repair of Structures (L0255)			Lecture		1	1
Mineral Building Materials (L0253)			Lecture		2	2
Technology of mineral Building Materials (L0256) Project-/problem-based Learning 1 2			2			
Transport Processes in Building Ma	terials and Damage Processes (L0254) Lecture 1 1					1
Module Responsible	Prof. Frank Schmidt-Döhl					
Admission Requirements	None					
<b>Recommended Previous</b>	Basic knowledge about building materials, building physics and building chemistry, for example by the modules Principles o					
Knowledge	Building Materials and Building	Physics and Buildin	ng Materials and Buildir	g Chemistry.		
Educational Objectives	After taking part successfully, st	udents have reac	hed the following learni	ng results		
<b>Professional Competence</b>						
Knowledge	The students are able to describ	e the components	s of mineral building ma	terials and their functio	n in detail an	d to use them for t
	manufacture of special mineral	building materials	. They are able to show	the characteristics of m	ineral buildin	g materials. They
	able to describe the manufactur	e, properties and	fields of application of s	special mortars and spe	cial concretes	and the correlation
	of their material parameters. Th	ey are able to sho	w the principles of anch	or technology and desig	gn.	
o						
Skills	Skills The students are able to perform an optimization of granulometry of a mineral building material. They are able to d					• •
	mineral mortar and to manufacture this mortar. The students are able to manufacture post installed rebar con				,	
	able to recognize damages, to	assess possible ca	auses, to use the funda	mentals of construction	preservation	and to select rep
	and strengthening measures.					
Deveenal Competence						
Personal Competence	The students are able to develo	n in small group t	he mixture of a special	martar Thou procent th	air requite to	the lasturer and t
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	-	nu anu aujust their res	suits. The students are	able to mant	nacture their spec
	building material on the basis of	this reedback.				
<b>A</b> (1) (1)	The students are able to responsibly use the resources of materials and lab equipment for their project and to investigate and t					
Autonomy		isibly use the reso	ources of materials and	lab equipment for their	project and	to investigate and
	get missing components.					
Workload in Hours	Independent Study Time 110, S	tudy Time in Lectu	ire 70			
Credit points	6					
Course achievement	Compulsory Bonus Form		Description			
	Yes 20 % Subject	theoretical an	ıd			
	practical	work				
Examination	Written exam					
Examination duration and	120 min					
scale						
Assignment for the	Civil Engineering: Specialisation	Geotechnical Eng	ineering: Compulsory			
Following Curricula	Civil Engineering: Specialisation	Coastal Engineeri	ing: Elective Compulsor	y		
	Civil Engineering: Specialisation	Structural Engine	ering: Elective Compuls	ory		
	Civil Engineering: Specialisation					

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

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Steel Construction Project (L1206)		Project Seminar	4	6
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
<b>Recommended Previous</b>	Steel and Composite Structures			
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
<b>Professional Competence</b>				
Knowledge	Students are able to prepare a part of the wh	nole project and explain it to the others.		
Skills	Students can produce sketches and calculations of their part of the project. They are able to adjust their work in reaction			
	changing conditions resulting from other par	ticipants of the project.		
Personal Competence				
Social Competence	Students can present their results to other members of the group.			
	They have the ability to work for a broad agr	eement with respect to intergroup depende	ncies.	
	They can distribute and process tasks indepe	endently.		
Autonomy	Students can handle their part of the project	on their own resposibility-		
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	approx. 15-20 pages (without appendix)			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnica	l Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Coastal Eng	neering: Elective Compulsory		
	Civil Engineering: Specialisation Structural E	ngineering: Compulsory		

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

Courses				
Title		Тур	Hrs/wk	СР
Marine Geotechnics (L0548)		Lecture	1	2
Marine Geotechnics (L0549)		Recitation Section (large)	2	2
Steel Structures in Foundation and	Hydraulic Engineering (L1146)	Lecture	2	2
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>	complete modules: Geotechnics I-III, Mathem	atics I-III		
Knowledge				
	courses: Soil laboratory course			
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Time in	Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Geotechnica	l Engineering: Compulsory		
Following Curricula	Civil Engineering: Specialisation Structural Er	ngineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engi	neering: Compulsory		
	Theoretical Mechanical Engineering: Speciali	sation Maritime Technology: Elective Compulsory	1	
	Water and Environmental Engineering: Speci			
	Water and Environmental Engineering: Speci			
	Water and Environmental Engineering: Speci	alisation Water: Elective Compulsory		

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

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

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

Courses				
<b>Title</b> Smart Monitoring (L2762)		Typ Integrated Lecture	Hrs/wk 2	<b>CP</b> 2
Smart Monitoring (L2762) Smart Monitoring (L2763)		Recitation Section (small)	2	4
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
	Basic knowledge or interest in object-oriented modeling, pro	paramming and sensor technol	ogies are helpful	Interest in mode
Knowledge	research and teaching areas, such as Internet of Things, Ind skills of scientific working, are required. Basic knowledge in s	lustry 4.0 and cyber-physical sy	stems, as well a	
Educational Objectives	After taking part successfully, students have reached the follo	wing learning results		
Professional Competence				
	decentralized smart systems to be applied for continuous environment. In addition, the students will learn to design an analysis techniques, modern software design concepts, and e also part of this module. In small groups, the students of "intelligent" sensors to be implemented by the students. techniques. The smart monitoring systems will be mounted on scaled lab structures for validation purposes. The outcom module will "automatically" participate with their smart more written papers and oral examinations form the final grades. T	d to implement intelligent senso mbedded computing methodolo vill design smart monitoring s Specific focus will be put on on real-world (built or natural) so the of every group will be docum initoring system in the annual	or systems using gies. Besides lect ystems that inte the application of ystems, such as ented in a paper "Smart Monitorin	state-of-the-art da tures, project work egrate a number of machine learn bridges or slopes, . All students of t ng" competition. T
Skills				
Personal Competence				
Social Competence				
Autonomy				
	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement				
	Written elaboration			
	10 pages of work with 15-minute oral presentation			
scale				
-	Civil Engineering: Specialisation Water and Traffic: Elective Co			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: El			
	Civil Engineering: Specialisation Coastal Engineering: Elective Civil Engineering: Specialisation Structural Engineering: Elect			
	Civil Engineering: Specialisation Structural Engineering: Elective	, ,		
	Civil Engineering: Specialisation Geotechnical Engineering: Elective			
	Civil Engineering: Specialisation Structural Engineering: Elect			
	Civil Engineering: Specialisation Water and Traffic: Elective Co			
	Environmental Engineering: Specialisation Waste and Energy			
	Environmental Engineering: Specialisation Biotechnology: Ele			
	Environmental Engineering: Specialisation Water: Elective Co			
	Environmental Engineering: Specialisation Waste and Energy			
	Environmental Engineering: Specialisation Biotechnology: Ele			
	Environmental Engineering: Specialisation Water: Elective Co	mpulsory		
	Water and Environmental Engineering: Specialisation Cities: E	lective Compulsory		
	Water and Environmental Engineering: Specialisation Cities: E	lective Compulsory		
	Water and Environmental Engineering: Specialisation Environ	ment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Environ	ment: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Water:	Elective Compulsory		

Course L2762: Smart Monito	ring
Тур	Integrated Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	In this course, principles of smart monitoring will be taught, focusing on modern concepts of data acquisition, data storage, and data analysis. Also, fundamentals of intelligent sensors and embedded computing will be illuminated. Autonomous software and decentralized data processing are further crucial parts of the course, including concepts of the Internet of Things, Industry 4.0 and cyber-physical systems. Furthermore, measuring principles, data acquisition systems, data management and data analysis algorithms will be discussed. Besides the theoretical background, numerous practical examples will be shown to demonstrate how smart monitoring may advantageously be used for assessing the condition of systems in the built or natural environment.
Literature	

Course L2763: Smart Monito	ring
Тур	Recitation Section (small)
Hrs/wk	2
CP	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	The contents of the exercises are based on the lecture contents. In addition to the exercises, project work will be conducted, which will consume the majority of the workload. As part of the project work, students will design smart monitoring systems that will be tested in the laboratory or in the field. As mentioned in the module description, the students will participate in the "Smart Monitoring" competition, hosted annually by the Institute of Digital and Autonomous Construction. Students are encouraged to contribute their own ideas. The tools required to implement the smart monitoring systems will be taught in the group exercises as well as through external sources, such as video tutorials and literature.
Literature	

Module M1545. Meta	llic and Hybrid Light-weight	Flatenais		
Courses				
Title		Тур	Hrs/wk	СР
Joining of Polymer-Metal Lightweig	nt Structures (L0500)	Lecture	2	2
Joining of Polymer-Metal Lightweig		Practical Course	1	1
Metallic Light-weight Materials (L16	560)	Lecture	2	3
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge				
Educational Objectives	After taking part successfully, students I	have reached the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 110, Study Tim	ne in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Oral exam			
Examination duration and	45 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structur	ral Engineering: Elective Compulsory		
Following Curricula	Materials Science: Specialisation Engine	ering Materials: Elective Compulsory		
-	Materials Science: Specialisation Engine	ering Materials: Elective Compulsory		
	Theoretical Mechanical Engineering: Spe	ecialisation Materials Science: Elective Compulso	rv	

Course L0500: Joining of Pol	ymer-Metal Lightweight Structures
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Marcus Rutner
Language	EN
Cycle	WiSe
Content	Contents:
	The lecture and the related laboratory exercises intend to provide an insight on advanced joining technologies for polymer-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. <b>Theoretical Lectures:</b>
	<ul> <li>Review of the relevant properties of Lightweight Alloys, Engineering Plastics and Composites in Joining Technology</li> <li>Introduction to Welding of Lightweight Alloys, Thermoplastics and Fiber Reinforced Plastics</li> <li>Mechanical Fastening of Polymer-Metal Hybrid Structures</li> <li>Adhesive Bonding of Polymer-Metal Hybrid Structures</li> <li>Fusion and Solid State Joining Processes of Polymer-Metal Hybrid Structures</li> <li>Hybrid Joining Methods and Direct Assembly of Polymer-Metal Hybrid Structures</li> </ul>
	Laboratory Exercises:     Joining Processes: Introduction to state-of-the-art joining technologies
	<ul> <li>Introduction to metallographic specimen preparation, optical microscopy and mechanical testing of polymer-metal joints</li> <li>Course Outcomes:</li> <li>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.</li> </ul>
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 Poly	urse L0501: Joining of Polymer-Metal Lightweight Structures	
Тур	Practical Course	
Hrs/wk	1	
СР	1	
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14	
Lecturer	Prof. Marcus Rutner	
Language	EN	
Cycle	WiSe	
Content	See interlocking course	
Literature	See interlocking course	

-	-weight Materials Lecture
Typ Hrs/wk	
	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Domonkos Tolnai
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 microstructure, mechanical qualities a applications
	Age-hardenable Al alloys: Processing and microstructure, mechanical qualities and applications
	Magnesium alloys
	Introduction to the fundamental of magnesium materials
	Alloy systems
	Magnesium casting alloys, processing, microstructure and qualities
	Magnesium wrought alloys, processing, microstructure and qualities
	Examples of applications
	Titanium alloys
	Introduction to the fundamental of the titanium materials
	Alloy systems
	Processing, microstructure and properties

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

Courses				
Courses				
Title Water Protection and Wastewater I		<b>Typ</b> Lecture	Hrs/wk	<b>СР</b> 3
Water Protection and Wastewater I	5	Project Seminar	3	3
Module Responsible		· <b>y</b> · · · · · ·		-
Admission Requirements	;			
Recommended Previous	None			
Knowledge	<ul> <li>Basic knowledge in water management;</li> </ul>			
	<ul> <li>Good knowledge in urban drainage;</li> </ul>			
	Good knowledge of wastewater treatmen			
	<ul> <li>Good knowledge of pollutants (e.g. COD,</li> </ul>	BOD, TS, N, P) and their properties;		
Educational Objectives	After taking part successfully, students have rea	ached the following learning results		
Professional Competence				
Knowledge	The students can describe the basic principles o	of the regulatory framework related to th	e international and Eu	ropean water sect
	They can explain limnological processes, subs	tance cycles and water morphology in	detail. They are able	e to assess compl
	problems related to water protection, such as	ecosystem service and wastewater tree	atment with a special	focus on innovat
	solutions, remediation measures as well as cond	ceptual approaches.		
Skills	Students can accurately assess current probler	ns and situations in a country-specific o	r local context. They c	an suggest concre
	actions to contribute to the planning of tomo			
	administrative and legislative solutions to solve		, ,	
Personal Competence	<b>-</b>			
Social Competence	The students can work together in international	groups.		
Autonomy	Students are able to organize their work flow to	p prepare presentations and discussions	. They can acquire ap	propriate knowled
	by making enquiries independently.			
	Independent Study Time 96, Study Time in Lect	ure 84		
Credit points				
Course achievement				
Examination				
Examination duration and scale	Term paper plus presentation			
Scale				
Assignment for the	Civil Engineering: Specialisation Structural Engin	neering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering	ngineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engine	ering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traf	fic: Elective Compulsory		
	Environmental Engineering: Specialisation Wate			
	International Management and Engineering: Spe	• •		
	Joint European Master in Environmental Studies		n Water: Elective Comp	oulsory
	Water and Environmental Engineering: Specialis			
	Water and Environmental Engineering: Specialis			
	Water and Environmental Engineering: Specialis	ation Environment: Compulsory		

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

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

Courses				
Title		Тур	Hrs/wk	СР
Examination of Materials, Structura	al Condition and Damages (L0260)	Lecture	3	4
Examination of Materials, Structura	al Condition and Damages (L0261)	Recitation Section (small)	1	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
<b>Recommended Previous</b>	Basic knowledge about building materials or m	aterial science, for example by the mo	dule Building Ma	aterials and Build
Knowledge	Chemistry.			
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
<b>Professional Competence</b>				
Knowledge	The students are able to describe the rules for tr	ading, use and marking of construction pr	oducts in Germar	ny. They know whi
	methods for the testing of building material prope	rties are usable and know the limitations a	nd characterics o	f the most import
	testing methods.			
Chille	The students are able to responsibly discover the	allos for trading and using of building prod	usta in Cormony	
SKIIIS	The students are able to responsibly discover the i			tion of domograp
	They are able to chose suitable methods for the to			
	the examination of the structural conditions of bui are able to describe an examination in form of a t		nptons to the cau	se of damages. If
Personal Competence				
Social Competence	The students can describe the different roles of r	nanufacturers as well as testing, supervise	ory and certificati	on bodies within
	framework of material testing. They can describe t	he different roles of the participants in leg	al proceedings.	
Autonomy	The students are able to make the timing and the	operation steps to learn the specialist know	vledge of a very e	extensive field.
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Enginee	ering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engi	neering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering	ng: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory		
	International Management and Engineering: Speci	alisation II. Civil Engineering: Elective Com	oulsory	
	Materials Science: Specialisation Engineering Mate	rials: Elective Compulsory		

## Course L0260: Examination of Materials, Structural Condition and Damages Typ Lecture Image: Colspan="2">Image: Colspan="2" Image: Cols

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

Courses				
Courses				
Title	7)	<b>Typ</b> Lecture	Hrs/wk 3	<b>CP</b> 4
Nonlinear Structural Analysis (L027 Nonlinear Structural Analysis (L027		Recitation Section (small)	1	2
	Prof. Alexander Düster			
Admission Requirements	None			
	Knowledge of partial differential equations i	s recommended		
Knowledge				
Educational Objectives	After taking part successfully, students hav	e reached the following learning results		
Professional Competence	51			
	Students are able to			
	+ give an overview of the different nonlinea	ar phenomena in structural mechanics.		
		nlinear phenomena in structural mechanics.		
		al analysis, to identify them in a given situation a	nd to explain the	eir mathematical
	mechanical background.			
CL ///-				
Skills	Students are able to			
	+ model nonlinear structural problems.			
	+ select for a given nonlinear structural pro			
	<ul> <li>+ apply finite element procedures for nonlin</li> <li>+ critically verify and judge results of nonlin</li> </ul>	-		
	+ to transfer their knowledge of nonlinear s	olution procedures to new problems.		
Personal Competence				
Social Competence	Students are able to			
	+ solve problems in heterogeneous groups.			
	+ present and discuss their results in front	of others.		
	+ give and accept professional constructive	e criticism.		
Autonomy	Students are able to			
Autonomy	+ assess their knowledge by means of exer	cises and E-Learning		
		knowledge to solve research oriented tasks.		
	+ to transform the acquired knowledge to s			
	r to transform the dequired knowledge to b			
Workload in Hours	Independent Study Time 124, Study Time ir	Lecture 56		
Credit points				
Course achievement				
Examination				
Examination duration and				
scale				
	Civil Engineering: Specialisation Structural I	Engineering: Elective Compulsory		
Following Curricula		: Specialisation II. Civil Engineering: Elective Com	oulsory	
<b>J</b>	Materials Science: Specialisation Modeling:		-	
	Mechatronics: Specialisation System Design			
		tion: Core Qualification: Elective Compulsory		
	Naval Architecture and Ocean Engineering:			
	Ship and Offshore Technology: Core Qualific			
	Theoretical Mechanical Engineering: Specia			

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

Course L0279: Nonlinear 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	

S							
Courses							
Fitle	Characteristic	(1.0500)		Ту	•	Hrs/wk	СР
Computational Analysis of Concrete					ture	2 1	3 1
Computational Analysis of Concrete E-Modeling of Concrete Structures		(LU599)			citation Section (large) ject-/problem-based Learning	1	2
Module Responsible		ar Romba	ch	110	Jeet /problem bused Learning	2	2
-	None						
-		vledae in s	structural analysis and	design of reinforced conc	rete structures (beams, slab	s. shear walls	).
Knowledge						-,,	
J	Lectures '	Concrete	Structures I und II'				
	Lectures 'S	Structural	Analysis I and II'				
	Lecture 'Co	oncrete St	ructures'				
Educational Objectives	After takin	g part suc	cessfully, students hav	ve reached the following le	earning results		
Professional Competence							
Knowledge	The students know the problems of numerical modeling and design of an arbitrary concrete structure.						
<i></i>							
Skills	The students can model and design an arbitrary concrete structure by means of a finite element software package.						
Personal Competence							
Social Competence	The studer	nts can me	odel and design in tear	mwork a real concrete stru	cture by means of a finite el	ement softwa	re package.
	y The students can model and design a real concrete structure based on a finite element software package and discuss the pr and results with other students.				discuss the problei		
	and results	s with oth	er students.				
Workload in Hours	Independe	nt Study 1	Гіте 110, Study Time і	in Lecture 70			
Credit points	6						
Course achievement	Compulsory	Bonus	Form	Description			
	Yes	None	Attestation	Am Ende des S	Semster ist ein Tragsystem	n mit dem R	echenprogramm z
				modellieren			
	Yes	None	Excercises	Es ist ein Tragsys	stem mit TEDDY zu modellier	en	
Examination	Oral exam						
Examination duration and	45 min						
scale							
Assignment for the	Civil Engin	eering: Sp	ecialisation Structural	Engineering: Elective Con	npulsory		
Following Curricula	Civil Engin	eering: Sp	ecialisation Geotechni	ical Engineering: Elective	Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory						

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

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

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

Courses					
Title			<b>Typ</b> Practical Course	Hrs/wk	<b>CP</b> 2
Waste and Environmental Chemisti Biological Waste Treatment (L0318	-		Project-/problem		4
Module Responsible				, , , , , , , , , , , , , , , , , , ,	
Admission Requirements					
Recommended Previous		l hasics			
Knowledge	chemical and biologica	1 503103			
Educational Objectives	After taking part succes	ssfully, students have re	ached the following learning resu	lts	
Professional Competence	······ ·······························				
	design and layout of ar	aerobic and aerobic wa	ng the planning of biological waste ste treatment plants in detail, des d explain different methods for wa	cribe different techniques for	
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					
Social Competence	Students can participa	te in subject-specific ar	d interdisciplinary discussions, de	evelop cooperated solutions a	and defend their ov
	work results in front of others and promote the scientific development in front of colleagues. Furthermore, they can give an				
	accept professional cor	istructive criticism.			
Autonomy	are capable, in consulta	ation with supervisors a rthermore, they can de	om literature, business or test rep s well as in the interim presentation fine targets for new application-o	on, to assess their learning lev	vel and define furth
Workload in Hours	Independent Study Tim	e 110, Study Time in Le	cture 70		
Credit points					
Course achievement		Form	Description		
		Subject theoretical practical work	and		
Examination					
Examination duration and	Elaboration and Presen	tation (15-25 minutes in	groups)		
scale					
Assignment for the	Civil Engineering: Spec	ialisation Structural Eng	ineering: Elective Compulsory		
Following Curricula		-	Engineering: Elective Compulsory		
-			ering: Elective Compulsory		
	Civil Engineering: Spec	ialisation Water and Tra	ffic: Elective Compulsory		
	Environmental Enginee	ring: Core Qualification	Compulsory		
	International Managem	ent and Engineering: S	ecialisation II. Energy and Enviror	nmental Engineering: Elective	Compulsory
			s - Cities and Sustainability: Speci	•••	npulsory
	Water and Environmen	tal Engineering: Special	sation Cities: Elective Compulsory		
			sation Environment: Elective Com		

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

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

Courses				
Title		Тур	Hrs/wk	СР
Chemistry of Drinking Water Treatment (L0311)		Lecture	2	1
Chemistry of Drinking Water Treatr	nent (L0312)	Recitation Section (large)	1	2
Water Resource Management (L04)		Lecture	2	2
Water Resource Management (L04)		Recitation Section (small)	1	1
Module Responsible				
Admission Requirements	None			
<b>Recommended Previous</b>	Knowledge of water management and the	e key processes involved in water treatment.		
Knowledge				
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
	water supply. They will understand relevant economic, environmental and social factors. Students will be able to explain a outline the organisational structures of water companies. They will be able to explain the available water treatment processes the scope of their application.			
Skills	Students will be able to assess complex problems in drinking water production and establish solutions involving was management and technical measures. They will be able to assess the evaluation methods that can be used for this. Students be able to carry out chemical calculations for selected treatment processes and apply generally accepted technical rules standards to these processes.			
Personal Competence				
Social Competence	Working in a diverse group of specialists,	students will be able to develop and documen	t complex solutions	for the managem
	and treatment of drinking water. They w	ill be able to take an appropriate professional	position, for examp	ole representing u
	interests. They will be able to develop joir	nt solutions in teams of diverse experts and pres	ent these solutions t	to others.
Autonomy	Students will be in a position to work on a subject independently and present on this subject.			
Workload in Hours	Independent Study Time 96, Study Time i	n Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	60 min (chemistry) + presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structura	l Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechr			
	Civil Engineering: Specialisation Water an			
	Civil Engineering: Specialisation Coastal E			
		ng: Specialisation II. Energy and Environmental E	ngineering: Elective	Compulsory
		onmental Process Engineering: Elective Compuls		
	Process Engineering: Specialisation Proces		-	
	Water and Environmental Engineering: Sp			
	Water and Environmental Engineering: Sp	ecialisation Environment: Elective Compulsory		

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

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

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

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

Courses					
Courses					
Title Basics of Coastal Engineering (L08)	171	<b>Typ</b> Lecture	Hrs/wk	<b>CP</b> 4	
Basics of Coastal Engineering (LU8) Basics of Coastal Engineering (L14)		Project-/problem-based Learning	1	2	
Module Responsible			_	_	
Admission Requirements					
	Basics of hydraulic engineering, hydrology and hydro	mechanics			
Knowledge					
Educational Objectives	After taking part successfully, students have reached	the following learning results			
Professional Competence					
Knowledge	The students are able to define and explain the basic	concepts of coastal engineering and port e	ngineering. T	hey are able to ap	
	the concepts to selected practical problems of coastal engineering. Students can define and determine the basics for design ar				
	dimensioning of coastal engineering constructions.				
CL 111					
SKIIIS	The students are capable to apply basic design approaches to selected and pre-defined design tasks in coastal engineer		l engineering.		
Personal Competence					
Social Competence	The students are able to deploy their gained knowledge in applied problems such as the design of coastal protection structures				
	Additionaly, they will be able to work in team with en	gineers of other disciplines, for instance des	signing of coa	stal breakwaters.	
Autonomy	my The students will be able to independently extend their knowledge and applyit to new problems.				
Autonomy	The students will be able to independently extend the	en knowledge and appryle to new problems.			
Workload in Hours	Independent Study Time 124, Study Time in Lecture	56			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	The duration of the examination is 2 hours. The examination includes tasks with respect to the general understanding		understanding of t		
scale	lecture contents and calculations tasks.				
Assignment for the	the Civil Engineering: Specialisation Structural Engineering: Elective Compulsory				
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine	ering: Compulsory			
	Civil Engineering: Specialisation Coastal Engineering:	Compulsory			
	International Management and Engineering: Specialis	ation II. Civil Engineering: Elective Compuls	orv		

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

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

Courses	
Title	Typ Hrs/wk CP
Integrated Transportation Planning	
	Prof. Carsten Gertz
	None
Recommended Previous	some knowledge of transport planning, e.g. through taking the undergraduate class "Transport Planning and Traffic Engineerin
Knowledge	
Educational Objectives	After taking part successfully, students have reached the following learning results
Professional Competence	After taking pure successibility, state ins have reached the following learning results
	Students are able to:
Kilowicage	
	<ul> <li>describe interdependencies between land-use/location choice and transportation/mobility behaviour</li> </ul>
	<ul> <li>explain and evaluate the social, ecological and economic effects of transport and land-use policy measures.</li> </ul>
	<ul> <li>relate current issues in the area of integrated transport planning and formulate an opinion on them.</li> </ul>
Skills	Students are able to:
	quantify important parameters, which influence travel demand or are influenced by it.
	<ul> <li>comprehensively examine a pre-defined or self-selected topic from a transportation studies perspective and document</li> </ul>
	results in accordance with scientific conventions.
Personal Competence	
Social Competence	Students are able to:
	provide feedback on topical contents and their teaching.
	<ul> <li>constructively handle feedback on their own work.</li> <li>produce regults in group work and decument these</li> </ul>
	produce results in group work and document these.
Autonomy	Students are able to:
	assess potential consequences of their future professional activities
	• independently plan working on a pre-defined project topic, acquire the necessary knowledge and use appropriate means
	its execution.
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Credit points	6
Course achievement	None
Examination	Written elaboration
Examination duration and	written assignment with presentation during the semester
scale	
-	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
	Civil Engineering: Specialisation Water and Traffic: Compulsory
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and Mobility: Elective Compulsory
	Water and Environmental Engineering: Specialisation Water: Elective Compulsory
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsory Water and Environmental Engineering: Specialisation Cities: Compulsory

Course L1068: Integrated Tr	ansportation Planning
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Carsten Gertz, Dr. Philine Gaffron, Jacqueline Bianca Maaß
Language	DE
Cycle	WiSe
	The course will provide students with an understanding of interdependencies between land-use and transportation. Specific topics include a.o.:    interactions between transport and the environment and consequent limitations  characteristics of integrated planning  complex planning processes  interdependencies of location choice and mobility behaviour  transport and land-use policies  project on current issues in transportation studies
Literature	Kutter, Eckhard (2005) Entwicklung innovativer Verkehrsstrategien für die mobile Gesellschaft. Erich Schmidt Verlag. Berlin. Bracher, Tilman u. a. (Hrsg.) (68. Ergänzung 2013) Handbuch der kommunalen Verkehrsplanung. Herbert Wichmann Verlag. Berlin, Offenbach. (Loseblattsammlung mit kontinuierlichen Ergänzungen)

ourses					
Title			Тур	Hrs/wk	СР
Applied Tunnel Constructions (L240	)7)		Lecture	2	3
ntroduction to tunnel construction	(L0707)		Lecture	1	2
ntroduction to tunnel construction	(L1811)		Recitation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe				
Admission Requirements	None				
<b>Recommended Previous</b>	Modules from Bachelor	studies Civil and environr	nental engineering:		
Knowledge	Geotechnics I-II				
Educational Objectives	After taking part succes	ssfully, students have read	hed the following learning results		
Professional Competence					
Knowledge	Knowledge of different t	tunnel construction types	as well as special methods and techniques	of subsoil constru	ction.
Skills	Basic knowledge of tunnel design as well as practical skills in structural tunnel analysis.				
Personal Competence					
Social Competence	Capacity for teamwork	concerning project manag	ement and design of tunnels.		
Autonomy	Promotion of independent and creative work flow in the framework of a design exercise.				
Workload in Hours	Independent Study Time	e 124, Study Time in Lect	ure 56		
Credit points	6				
Course achievement	Compulsory Bonus I	Form	Description		
	No 5% I	Excercises			
Examination	Written exam				
Examination duration and	120 minutes				
scale					
Assignment for the	Civil Engineering: Speci	ialisation Structural Engine	eering: Elective Compulsory		
Following Curricula	Civil Engineering: Speci	alisation Geotechnical Eng	gineering: Compulsory		
	Civil Engineering: Speci	ialisation Coastal Enginee	ing: Compulsory		
	Civil Engineering: Speci	ialisation Water and Traffi	c: Elective Compulsory		
			cialisation II. Civil Engineering: Elective Com		

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

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

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

Title         Typ         Hrs/wk         CP           Module Responsible         Dozenten des SD B         Admission Requirements         None           Recommended Previous         Subjects of the Structural Engineering specialisation.         Knowledge           Educational Objectives         After taking part successfully, students have reached the following learning results         Professional Comptence           Knowledge         The students are able to demonstrate their detailed knowledge in the field of structural and construction engineering. The exemplify the state of technology and application and discuss critically in the context of actual problems and general conditi science and society.           The students can develop solving strategies and approaches for fundamental and practical problems in structural and constructive 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 methods relate to the field of work and how the context of application has to be adjusted. General findings and f developments may essentially be outlined.           Personal Comptence         Skills         The students are able to condense the relevance and the structure of the project work, the work steps and the sub-problet the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to colleagues.           Autonomy         The students are capable of independently planning and docume	Courses		
Admission Requirements         None           Recommended Previous         Subjects of the Structural Engineering specialisation.           Knowledge         After taking part successfully, students have reached the following learning results           Professional Competence         Knowledge           Knowledge         The students are able to demonstrate their detailed knowledge in the field of structural and construction engineering. The exemplify the state of technology and application and discuss critically in the context of actual problems and general conditis science and society.           The students can develop solving strategies and approaches for fundamental and practical problems in structural and construction of science and society.           Skills         The students are able to independently select methods for the project work and to justify this choice. They can explain how methods relate to the field of work and how the context of application has to be adjusted. General findings and f 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-problet the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to colleagues.           Autonomy         The students are capable of independently planning and documenting the work steps and procedures while considering the dealines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain fee from experts with regard to the progress of the work, and to accomplish results on the state of the art in sc	Title	Typ Hrs/wk CP	
Recommended Previous Knowledge         Subjects of the Structural Engineering specialisation.           Professional Objectives         After taking part successfully, students have reached the following learning results           Professional Competence Knowledge         The students are able to demonstrate their detailed knowledge in the field of structural and construction engineering. The exemplify the state of technology and application and discuss critically in the context of actual problems and general conditi science and society.           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 of science and society.           Skills         The students are able to independently select methods for the project work and to justify this choice. They can explain how methods relate to the field of work and how the context of application has to be adjusted. General findings and f 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-problet the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to colleagues.           Autonomy         The students are capable of independently planning and documenting the work steps and procedures while considering the deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain fee from experts with regard to the progress of the work, and to accomplish results on the state of the art in s	Module Responsible	Dozenten des SD B	
Knowledge         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. The exemplify the state of technology and application and discuss critically in the context of actual problems and general conditis science and society.           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 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 methods relate to the field of work and how the context of application has to be adjusted. General findings and f 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-problem the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to colleagues.           Autonomy         The students are capable of independently planning and documenting the work steps and procedures while considering the dealines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain fee from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technologe fro	Admission Requirements	None	
Educational Objectives       After taking part successfully, students have reached the following learning results         Professional Competence       Knowledge         Knowledge       The students are able to demonstrate their detailed knowledge in the field of structural and construction engineering. The exemplify the state of technology and application and discuss critically in the context of actual problems and general conditi science and society.         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 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 methods relate to the field of work and how the context of application has to be adjusted. General findings and f developments may essentially be outlined.         Personal Competence       Social Competence         Social Competence       The students are capable of independently planning and documenting the work steps and procedures while considering the deadines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain fee from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technologing the deadines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain fee from experts with regard to the progress of the work, and	<b>Recommended Previous</b>	Subjects of the Structural Engineering specialisation.	
Professional Competence Knowledge         The students are able to demonstrate their detailed knowledge in the field of structural and construction engineering. The exemplify the state of technology and application and discuss critically in the context of actual problems and general conditi science and society.           The students can develop solving strategies and approaches for fundamental and practical problems in structural and constru- engineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view 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 methods relate to the field of work and how the context of application has to be adjusted. General findings and f 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-problem the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to colleagues.           Autonomy         The students are capable of independently planning and documenting the work steps and procedures while considering the deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain fee from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technolo (Credit points 6           Course achievement         None           Examination	Knowledge		
Knowledge       The students are able to demonstrate their detailed knowledge in the field of structural and construction engineering. The exemplify the state of technology and application and discuss critically in the context of actual problems and general conditi science and society.         The students can develop solving strategies and approaches for fundamental and practical problems in structural and construering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view 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 methods relate to the field of work and how the context of application has to be adjusted. General findings and f developments may essentially be outlined.         Personal Competence       Social Competence         Social Competence       The students are capable of independently planning and documenting the work steps and procedures while considering the deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain fee from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technologies of the work, and to accomplish results on the state of the art in science and technologies.         Workload in Hours       Independent Study Time 180, Study Time in Lecture 0         Credit points       6         Course achievement       None         Examination       None <td>Educational Objectives</td> <td>After taking part successfully, students have reached the following learning results</td> <td></td>	Educational Objectives	After taking part successfully, students have reached the following learning results	
exemplify the state of technology and application and discuss critically in the context of actual problems and general conditiscience and society.         The students can develop solving strategies and approaches for fundamental and practical problems in structural and construengineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view 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 methods relate to the field of work and how the context of application has to be adjusted. General findings and f 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-problem to rolleagues.         Autonomy       The students are capable of independently planning and documenting the work steps and procedures while considering the deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain fee from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technologies achievement         Workload in Hours       Independent Study Time 180, Study Time in Lecture 0         Credit points       6         Course achievement       None	Professional Competence		
engineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view 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 methods relate to the field of work and how the context of application has to be adjusted. General findings and f 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-problem the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to colleagues.         Autonomy       The students are capable of independently planning and documenting the work steps and procedures while considering the deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain fee from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology to the progress achievement         None       Course achievement         Examination       Study work	Knowledge	exemplify the state of technology and application and discuss critically in the context of actual problems and general conditi	-
Skills       The students are able to independently select methods for the project work and to justify this choice. They can explain how methods relate to the field of work and how the context of application has to be adjusted. General findings and f 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-problem the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to colleagues.         Autonomy       The students are capable of independently planning and documenting the work steps and procedures while considering the deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feedfrom experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology.         Workload in Hours       Independent Study Time 180, Study Time in Lecture 0         Credit points       6         Course achievement       None         Examination       Study work		engineering. They may apply theory based procedures and integrate safety-related, ecological, ethical, and economic view	
Personal Competence       Social Competence         Social Competence       The students are able to condense the relevance and the structure of the project work, the work steps and the sub-problem         Autonomy       The students are capable of independently planning and documenting the work steps and procedures while considering the deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain fee 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         Course achievement       None         Examination       Study work		Scientific work techniques that are used can be described and critically reviewed.	
Social Competence       The students are able to condense the relevance and the structure of the project work, the work steps and the sub-problem the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to colleagues.         Autonomy       The students are capable of independently planning and documenting the work steps and procedures while considering the deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain fee from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology         Workload in Hours       Independent Study Time 180, Study Time in Lecture 0         Credit points       6         Course achievement       None         Examination       Study work	Skills	methods relate to the field of work and how the context of application has to be adjusted. General findings and f	
Autonomy       The students are capable of independently planning and documenting the work steps and procedures while considering the deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain fee from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology         Workload in Hours       Independent Study Time 180, Study Time in Lecture 0         Credit points       6         Course achievement       None         Examination       Study work	Personal Competence		
deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain feed from experts with regard to the progress of the work, and to accomplish results on the state of the art in science and technology         Workload in Hours       Independent Study Time 180, Study Time in Lecture 0         Credit points       6         Course achievement       None         Examination       Study work		the presentation and discussion in front of a bigger group. They can lead the discussion and give a feedback on the project to	
Credit points       6         Course achievement       None         Examination       Study work	Autonomy	deadlines. This includes the ability to accurately procure the newest scientific information. Furthermore, they can obtain fee	dba
Course achievement     None       Examination     Study work	Workload in Hours	Independent Study Time 180, Study Time in Lecture 0	
Examination Study work	Credit points	6	
	Course achievement	None	
Examination duration and see FSPO	Examination	Study work	
	Examination duration and	see FSPO	
scale	scale		

## Module M0969: Selected Topics in Civil Engineering

Courses				
Title	Тур		Hrs/wk	СР
Ergonomics (L0653)	Lecture		2	3
Construction robotics (L0708)	Project-/problem-base	ed Learning	3	3
Analysis of Offshore Structures (L18	367) Lecture		1	1
Excellence in International Project	Delivery (L2387) Integrated Lecture		2	2
Design of Prefabricated Concrete St	tructures (L0596) Lecture		1	1
Design of Prefabricated Concrete St	tructures (L0597) Recitation Section (lar	rge)	1	1
Forum I - Geotechnics and Construct	ction Management (L1634) Seminar		1	1
Forum II - Geotechnics and Constru-	ction Management (L1635) Seminar		1	1
Geotechnical Engineering Design (L	2447) Lecture		2	3
Timber Structures (L1151)	Seminar		2	2
Innovative Timber Construction (L2)	666) Lecture		2	3
Glass Structures (L1152)	Lecture		2	2
Glass Structures (L1447)	Recitation Section (lar	5	1	1
-	nation of concrete members (L2725) Project-/problem-base	ed Learning	2	2
Special topics of civil engineering 1			1	1
Special topics of civil engineering 2			2	2
Special topics of civil engineering 3			3	3
Structural Design (L2789)	Seminar		2	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
<b>Recommended Previous</b>	none			
Knowledge				
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 through selected special areas within civil and structural engineering.</li> <li>Students are able to explain basic models and procedures in selected special areas of civil and structural engineering.</li> <li>Students are able to interrelate scientific and technical knowledge.</li> </ul>			
Skills	• Students are able to apply basic methods in selected areas of civil and structural engineering.			
Personal Competence				
Social Competence				
Autonomy	<ul> <li>Students can chose independently, in which fields they want to deepen their</li> </ul>	knowledge a	and skills th	rough the election
	• Students can chose independently, in which helds they want to deepen their courses.			
Workload in Hours				
Workload in Hours Credit points	courses.			
Credit points	courses.			
Credit points Assignment for the	courses. Depends on choice of courses 6			
Credit points Assignment for the	courses. Depends on choice of courses 6 Civil Engineering: Specialisation Structural Engineering: Elective Compulsory			

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

Course L0708: Construction	robotics
Тур	Project-/problem-based Learning
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Examination Form	Mündliche Prüfung
Examination duration and	15 min
scale	
Lecturer	Francisco Williams Riquer
Language	DE
Cycle	WiSe
Content	The students learn in the lecture the required knowledge in control systems to apply it to a specific project-based geotechnical problem. In a two-weeks time frame, students can test developed control strategies in the lab and present their results. At the end of the lecture, students will have an oral examination.
Literature	Ogata, Katsuhiko. Modern control engineering. Vol. 5. Upper Saddle River, NJ: Prentice hall, 2010. Ross, Timothy J. Fuzzy logic with engineering applications. John Wiley & Sons, 2005.

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

Course L2387: Excellence in	International Project Delivery
Тур	Integrated Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Klausur
Examination duration and	2 h
scale	
Lecturer	Dr. Jens Huckfeldt
Language	EN
Cycle	SoSe
Content	Simply and easy to avoid mistake in project delivery can deliver projects within budget and as per schedule.You
	have to attend if you see yourself in project execution and potentially even abroad.
Literature	

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

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

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

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

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

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

Course L2666: Innovative Timber Construction	
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Examination Form	Schriftliche Ausarbeitung
Examination duration and	45 Minuten
scale	
Lecturer	Dr. Andreas Meisel
Language	DE
Cycle	WiSe
Content	
Literature	- Blass, J.: "Ingenieurholzbau"
	- Schickhofer, G.: "BSPhandbuch: Holz-Massivbauweise in Brettsperrholz"
	- Informationsdienst Holz: div. Merkblätter und Broschüren
	- Wallner-Novak M.: Brettsperrholz Bemessung, Band 1 und 2
	- Gerner M.: "Fachwerk: Entwicklung, Instandsetzung, Neubau"
	- Meisel, A.: "Historische Dachwerke: Beurteilung, realitätsnahe statische Analyse und Instandsetzung"
	- Kempe K.: "Dokumentation Holzschädlinge"
	- Huckfeldt T.: "Hausfäule- und Bauholzpilze"

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

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

Course L2725: Testing and non-destructive examination of concrete members	
Тур	Project-/problem-based Learning
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Examination Form	Mündliche Prüfung
Examination duration and	20 min
scale	
Lecturer	Dr. Lukas Henze, Dr. Lukas Henze
Language	DE
Cycle	SoSe
Content	
Literature	

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

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

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Subsoil and Underground Engineer	ing Law (L0395)	Lecture	2	3
Service Contract and Procurement	Law (L1906)	Lecture	2	3
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>	Complete modules: Geotechnics I-III			
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	Students will gain knowledge of			
	<ul> <li>the history of civil engineering law,</li> </ul>			
	<ul> <li>basics of foundation and civil engineer</li> </ul>	ing law		
	<ul> <li>legal aspects of technical regulations in</li> </ul>			
	<ul> <li>the civil engineering contract,</li> </ul>			
	<ul> <li>the liability of the designer and contract</li> </ul>	ctor in civil engineering.		
	<ul> <li>the subsoil risk and the system risk,</li> </ul>			
	<ul> <li>the total debt in (civil) engineering law</li> </ul>	,		
		idance models and the construction proce	SS,	
	• the systematics of construction contra	ct law,		
	<ul> <li>the BGB construction contract law,</li> </ul>			
	<ul> <li>responsibilities on the construction site</li> </ul>	2,		
	<ul> <li>remuneration and contract manageme</li> </ul>	nt,		
	<ul> <li>liability for defects,</li> </ul>			
	<ul> <li>public procurement law.</li> </ul>			
Skills	Students learn to apply legal aspects in planr	ing and construction in a legally balanced	l way.	
Personal Competence				
	Students can work in groups and support eac	h other in finding solutions.		
Autonomy	Students are able to assess their own strengt	hs and weaknesses and organize their tim	e and learning manage	ment based on thi
Workload in Hours	Independent Study Time 124, Study Time in I	Lecture 56		
Credit points	6			
Course achievement	None			
Examination				
Examination duration and	30 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering	neering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnica	• • • • •		
	Civil Engineering: Specialisation Structural En	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Tr	affic: Elective Compulsory		

Тур	Lecture
Hrs/wk	2
CP	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Günther Schalk
Language	DE
Cycle	WiSe
Content	History of Civil Engineering Law (from 1700 BC to 2000 AD)
	• Basics of foundation and excarvation law / engineering law (the participants in the case law of geotechnical law case studies)
	Legal aspects of technical regulations in civil engineering (with case studies)
	• The civil engineering contract (including checklists for the special civil engineering contract design and execution)
	• The liability of the planner and entrepreneur in civil engineering (practical examples, jurisprudence and law, inter alia, to t
	Ordinance on Combatants, liability for defects and traffic safety obligations, construction law and insurance questions)
	• The ground / foundation risk and the systemic risk (also in the European context)
	• The total debt in (low) building law (based on practice-oriented case constellations)
	• The (construction) conflict, the dispute avoidance models and the construction process (practice-oriented presentation)
Literature	Folienskript (in der Vorlesung erhältlich)
	weitere Literatur:
	Englert, Grauvogel und Maurer: Handbuch des Baugrund- und Tiefbaurechts. Werner-Verlag

Course L1906: Service Contr	ourse L1906: Service Contract and Procurement Law	
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Günther Schalk, Prof. Jürgen Grabe	
Language	DE	
Cycle	WiSe	
Content		
Literature		

Madula M1716, Cuba	utono Duonnon					
Module M1716: Subsu	Irrace Processes					
Courses						
Title		Тур	Hrs/wk	СР		
Modeling of Subsurface Processes (	L2731)	Recitation Section (small)	3	3		
Subsurface Solute Transport (L272)	3)	Lecture	2	2		
Subsurface Solute Transport (L272)	))	Recitation Section (large)	1	1		
Module Responsible	Prof. Nima Shokri					
Admission Requirements	None					
<b>Recommended Previous</b>	Basic Mathematics, Hydrology					
Knowledge						
Educational Objectives	After taking part successfully, students have reach	hed the following learning results				
Professional Competence						
Knowledge	Upon completion of this module, the students v	vill understand the mechanisms controlling	solute transpor	t in soil and natu		
	porous media and will be able to work with the eq	uations that govern the fate and transport o	of solutes in poro	us media. Analytic		
	numerical and experimental tools and techniques	will be used in this module.				
Skille						
SKIIIS	In addition to the physical insights, the students will be exposed to analytical, experimental and numerical tools and techniques this module. This provides them with an excellent opportunity to improve their skills on multiple fronts which will be useful in the					
	future career.	opportunity to improve their skins on multi	ple fronts which	will be useful in th		
Personal Competence						
	Teamwork & problem solving					
Autonomy	The students will be involved in writing individ	ual reports and presentation. This will con-	atribute to the s	tudents' ability a		
hatohomy	willingness to work independently and responsibly			addenes ability a		
Workload in Hours	Independent Study Time 96, Study Time in Lectur					
Credit points	6					
Course achievement	None					
Examination	Subject theoretical and practical work					
Examination duration and	Report and Presentation					
scale						
Assignment for the	Civil Engineering: Specialisation Structural Engine	ering: Elective Compulsory				
Following Curricula	Civil Engineering: Specialisation Geotechnical Eng	ineering: Elective Compulsory				
	Civil Engineering: Specialisation Coastal Engineeri	ing: Elective Compulsory				
	Civil Engineering: Specialisation Water and Traffic	: Elective Compulsory				
	Process Engineering: Specialisation Environmenta	l Process Engineering: Elective Compulsory				
	Process Engineering: Specialisation Process Engin	eering: Elective Compulsory				
	Process Engineering: Specialisation Process Engin Water and Environmental Engineering: Specialisat	• • •				
		tion Water: Compulsory				

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

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

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

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

Course L2291: Adaptation to	o climate change in hydraulic engineering
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	<ul> <li>Climate protection and climate adaptation</li> <li>Findings on climate change and its regional characteristics: fundamentals of climate change, climate modelling / climate models</li> <li>Impacts of climate change on the components of the regional hydrological cycle(climate science view)</li> <li>Fundamentals of the analysis of climate data</li> <li>Concequences of the impacts of climate change (ingenieering science view)</li> <li>Measures for climate change adaptation</li> <li>Assessment, prioritization and communication of measures</li> <li>Fundamentals of analysis of hydrometeorological and hydrological data</li> </ul>
Literature	Bereitgestellte eLearning Plattform

Courses					
Title		Тур		Hrs/wk	СР
Scientific Working in Computationa	l Engineering (L2764)	Project-/problem-bas	sed Learning	4	6
Module Responsible	Prof. Kay Smarsly				
Admission Requirements	None				
<b>Recommended Previous</b>	Basic knowledge in scientific writing. String interest in topics related to computing in civil engineering.				
Knowledge					
Educational Objectives	After taking part successfully, students	have reached the following learning results			
Professional Competence					
<i>Skills</i> <b>Personal Competence</b> <i>Social Competence</i>	thinking, being able to accurately plar will be conducted throughout the seme this course, a scientific paper will be d	with each other, the students will also learn t n, implement and analyze scientific projects, ister, which will contribute to the grade. Since eveloped based, which is a prerequisite for t n this course. Project meetings in small gro ctivities.	such as pros scientific wr he final exam	spective mast riting is of part nination. The p	er theses. A proj icular importance paper will be writ
Autonomy					
	Independent Study Time 124, Study Tin	me in Lecture 56			
Credit points					
Course achievement					
	Written elaboration				
	10 pages of work with 15-minute oral p	presentation			
scale	Civil Engineering: Engelation	and Traffice Elective Compulsory			
-	Civil Engineering: Specialisation Water	chnical Engineering: Elective Compulsory			
i onowing cullicula	civil Engineering. Specialisation Geole	innear Engineering. Liective Compulsory			
	Civil Engineering: Specialisation Coasta	I Engineering: Elective Compulsory			

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

Courses				
Title		Тур	Hrs/wk	СР
Sustainable Nature-based Coastal	Protection in a Changing Climate (SeaPiaC) (L2926)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge	Hydraulic Engineering			
	<ul> <li>Hydromechanics, Hydraulics</li> <li>Fundamentals of Coastal Engineering, Coastal- a</li> </ul>	nd Flood Protection		
		In Hood Protection		
Educational Objectives	After taking part successfully, students have reached the	ne following learning results		
Professional Competence				
Knowledge	<ul> <li>Climate and Climate Change</li> </ul>			
	<ul> <li>Climate and Climate Change</li> <li>General Impacts of Climate Change on Wind Reg</li> </ul>	ime and Water Cycle		
	Consequences of Climate Change for Coastal Pro			
	<ul> <li>Coastal Protection in Taiwan and Germany</li> </ul>			
	Fundamentals of Climate Adaptation			
	Nature-based Solutions (NBS) for Coastal Protect	ion		
Skills	Critical thinking: analysis of processes and relativ	ons, assessment of needs for action		
	Creative thinking: development of adaptation str			
	Practical thinking: inclusion of restrictions, app	lication of calculation approaches, meth	nods, numerica	al models, plannii
	methods			
	Consideration of complex tasks			
Personal Competence				
Social Competence				
social competence	Working in heterogenous groups			
	Working in international groups			
	Working with different scientific / non-scientific d	isciplines		
	Self reflection			
Autonomy				
	Application oriented use of knowledge and skills			
	<ul> <li>Autonomous work on complex tasks</li> </ul>			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Preparation of a written report on a complex task with	a presentation and subsequent discussion	on. The work o	on the complex ta
scale	happens in the course of the lecture.			
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: E	ective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineer	ng: Elective Compulsory		
	Civil Engineering: Specialisation Structural Engineering			
	Civil Engineering: Specialisation Water and Traffic: Elec			
	Water and Environmental Engineering: Specialisation C	1 3		
	Water and Environmental Engineering: Specialisation E			
	Water and Environmental Engineering: Specialisation W	ater: Elective Compulsory		

Course L2926: Sustainable N	lature-based Coastal Protection in a Changing Climate (SeaPiaC)
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Peter Fröhle
Language	EN
Cycle	WiSe
Content	<ul> <li>Climate and Climate Change</li> <li>General Impacts of Climate Change on Wind Regime and Water Cycle</li> <li>Consequences of Climate Change for Coastal Processes</li> <li>Coastal Protection in Taiwan and Germany</li> <li>Fundamentals of Climate Adaptation</li> <li>Nature-Based Solutions (NBS) for Coastal Protection</li> </ul>
Literature	Materials provided on eLearning Platform (HOOU Platform)

Courses				
Title		Тур	Hrs/wk	СР
Modern discretization methods in s	tructural mechanics (L3043)	Lecture	2	3
Modern discretization methods in s	tructural mechanics (L3044)	Recitation Section (small)	2	3
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
Recommended Previous Knowledge	<ul><li>Finite Element Methods</li><li>Flächentragwerke</li></ul>			
Educational Objectives	After taking part successfully, students have	ve reached the following learning results		
<b>Professional Competence</b>				
Knowledge	After successful completion of this module mechanics.	, students can express the basic aspects of moder	n discretization r	methods in structu
Skills	After successful completion of this module, the students will be able to use and further improve modern discretization methods for problems in structural mechanics.			
Personal Competence				
Social Competence	Students can			
	<ul> <li>participate in subject-specific and in</li> </ul>	terdisciplinary discussions.		
	<ul> <li>defend their own work results in from</li> </ul>			
	<ul> <li>promote the scientific development</li> </ul>	of colleagues		
	Furthermore, they can give and account of the second	ept professional constructive criticism		
Autonomy	• •	e subject area from given and other sources and a cess for problems in the area of modern discretizati		oblems. Furthermo
Workload in Hours	Independent Study Time 124, Study Time	in Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
•	Civil Engineering: Specialisation Coastal Er			
Following Curricula	Civil Engineering: Specialisation Geotechni			
	Civil Engineering: Specialisation Structural	Engineering: Elective Compulsory		

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

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

Courses						
Title			Тур		Hrs/wk	СР
Finite element modeling of structures (L3046)			Lect		2	3
Finite element modeling of structur	res (L3047)		Reci	tation Section (small)	2	3
Module Responsible	Prof. Bastian Oesterle					
Admission Requirements	None					
<b>Recommended Previous</b>						
Knowledge	Finite Element N					
	<ul> <li>Thin-walled stru</li> </ul>	ictures				
Educational Objectives	After taking part succe	essfully, students have r	eached the following le	arning results		
Professional Competence						
Knowledge	After successful compl	etion of this module, stu	udents can express the	basic aspects of modell	ling of structures	with finite elements
Skills	After successful comp	letion of this module,	the students will be al	ole to model structures	s with finite elem	ents and to analys
	structures using appro	priate computational m	ethods.			
Personal Competence						
Social Competence						
boeiar competence						
	<ul> <li>participate in su</li> </ul>	bject-specific and intere	disciplinary discussions,			
	<ul> <li>defend their ow</li> </ul>	n work results in front o	f others			
	<ul> <li>promote the sci</li> </ul>	entific development of o	colleagues			
	• Furthermore, th	ey can give and accept	professional constructiv	ve criticism		
Autonomy	Students are able to g	ain knowledge of the su	bject area from given a	and other sources and a	apply it to new pro	blems. Furthermor
	-	ure the solution process				
Workload in Hours	Independent Study Tin	ne 124, Study Time in L	ecture 56			
Credit points		ne 124, Study fille if E				
Course achievement	Compulsory Bonus	Form	Description			
course acmevement	Yes 20 %	Subject theoretical	•	Finite-Elemente-Modell	lierungsaufgabe e	ines (Teil-)Tragwerl
		practical work	mit einer FE-So	ftware inklusive Dok	umentation und	Interpretation d
			Ergebnisse			
Examination	Written exam					
Examination duration and	60 min					
scale						
Assignment for the	Civil Engineering: Spec	cialisation Coastal Engin	eering: Elective Compu	lsory		
Following Curricula	Civil Engineering: Spec	cialisation Geotechnical	Engineering: Elective C	ompulsory		
			gineering: Elective Com			

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

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

Module M1845: Thin-	walled structures			
Courses				
Title		Тур	Hrs/wk	СР
Thin-walled structures (L1199)		Lecture	2	3
Thin-walled structures (L3045)		Recitation Section (large)	2	3
Module Responsible	Prof. Bastian Oesterle			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge	Structural Analysis I			
	Structural Analysis II     Sinite Element Methods			
	Finite Element Methods			
Educational Objectives	After taking part successfully, students have reached the	following learning results		
Professional Competence				
Knowledge	After successful completion of this module, the student	s can express the basic aspects of	the load-carryin	g behaviour of thir
	walled structures.			
SKIIIS	After successful completion of this module, the students	will be able to predict load-carrying	g benaviour of ti	nin-walled structure
	using appropriate analytical and coputational methods.			
Personal Competence				
Social Competence	Students can			
	<ul> <li>participate in subject energific and interdisciplinant.</li> </ul>	discussions		
	<ul> <li>participate in subject-specific and interdisciplinary</li> </ul>	discussions,		
	defend their own work results in front of others			
	promote the scientific development of colleagues	La contra del contra del del contra del contr		
	<ul> <li>Furthermore, they can give and accept professional</li> </ul>	Il constructive criticism		
Autonomy	Students are able to gain knowledge of the subject area	from given and other sources and ap	oply it to new pro	blems. Furthermore
	they are able to structure the solution process for problem	ns in the area of modelling and analy	ysis of thin-walle	d structures.
	Independent Study Time 124, Study Time in Lecture 56			
Credit points Course achievement	None			
Examination				
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Elec	ctive Compulsory		
Following Curricula				
-	Civil Engineering: Specialisation Structural Engineering: E			
	Civil Engineering: Specialisation Coastal Engineering: Elec			
	Civil Engineering: Specialisation Geotechnical Engineering			
	Civil Engineering: Specialisation Structural Engineering: E			
	Theoretical Mechanical Engineering: Specialisation Simula		ry	

Course L1199: Thin-walled st	tructures			
Тур	Lecture			
Hrs/wk	2			
CP	3			
Workload in Hours	ndependent Study Time 62, Study Time in Lecture 28			
Lecturer	of. Bastian Oesterle			
Language	DE			
Cycle	SoSe			
Content	Plates loaded in-plane			
	Governing equations (equilibrium, kinematics, constitutive law)			
	Differential equation			
	Airy stress function			
	Plane stress / plane strain			
	Structural behaviour of plates loaded in-plane			
	<ul> <li>finite elements for plates loaded in-plane, modelling apsects, interpretation and critical assessment of results</li> </ul>			
	Plates in bending			
	Governing equations (equilibrium, kinematics, constitutive law)			
	Differential equation			
	Navier solution / Fourier series expansion			
	Approximation procedures			
	Circular and rectangular plates			
	Structural behaviour of plates in bending			
	<ul> <li>finite elements for plates in bending, modelling apsects, interpretation and critical assessment of results</li> </ul>			
	Shells			
	Phenomenona of the structural behaviour of shells			
	Membrane and bending theory			
	Equilibrium equations of shells of revolution			
	Stress resultants and deformations of the spherical shell, the half spherical shell, and the cylindrical shell			
	finite elements for shells			
	Stability problems (overview)			
	Plate buckling			
	Shell buckling			
Literature				
	Vorlesungsmanuskript			
	Basar, Y.: Krätzig, W.B. (1985): Mechanik der Flächentragwerke. Vieweg-Verlag, Braunschweig, Wiesbaden			
	Girkmann, K. (1963): Flächentragwerke, Springer Verlag, Wien, 1963, unveränderter Nachdruck 1986			
	Zienkiewicz, O.C. (1977): The Finite Element Method in Enginieering Science. McGraw-Hill, London			

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

## **Specialization Water and Traffic**

## Module M1437: Non destructive testing of materials and parts Courses Title Тур Hrs/wk СР Non destructive testing of materials and parts (L2215) Lecture 2 2 3 Non destructive testing of materials and parts (L2217) Project-/problem-based Learning 3 Non destructive testing of materials and parts (L2216) Recitation Section (large) 1 1 Module Responsible Prof. Bodo Fiedler **Admission Requirements** None **Recommended Previous** Knowledge **Educational Objectives** After taking part successfully, students have reached the following learning results **Professional Competence** Knowledge Skills **Personal Competence** Social Competence Autonomy Workload in Hours Independent Study Time 96, Study Time in Lecture 84 Credit points 6 **Course achievement** None Examination Written elaboration Examination duration and Written document about theory and praxis scale Assignment for the Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Following Curricula Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Structural Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory Materials Science: Specialisation Engineering Materials: Elective Compulsory

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

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

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

Module M0964: Unde	rground Constructions			
Courses				
Title	-	Тур	Hrs/wk	СР
Applied Tunnel Constructions (L240	7)	Lecture	2	3
Introduction to tunnel construction	(L0707)	Lecture	1	2
Introduction to tunnel construction	(L1811)	Recitation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>	Modules from Bachelor studies Civil and e	environmental engineering:		
Knowledge				
	Geotechnics I-II			
	Steel Structures I-II			
Educational Objectives	After taking part successfully, students ha	ave reached the following learning results		
Professional Competence				
-	Knowledge of different tunnel construction	on types as well as special methods and techniqu	es of subsoil const	ruction. The studen
	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 constructions knowledge concerning duay wans. Futuennoie, the			
	choose the right construction elements depending on the influencing conditions.			
Skills	s Basic knowledge of tunnel design as well as practical skills in structural tunnel analysis. Furthermore, the students are able to			
	dimension sheet pile wall construction regarding all construction elements, to choose the suitable construction elements with			
	respect to the influencing conditions, to design all kinds of sheet pile walls (wave sheet pile walls and combined sheet pile walls)			
		nd to dimension all construction elements and connections.		
Personal Competence	and to amension an construction element			
	Capacity for teamwork concerning project	t management and design of tunnels		
Autonomy		vork flow in the framework of a design exercise.		
	Independent Study Time 124, Study Time	-		
Credit points				
Course achievement				
Examination				
Examination duration and				
scale	220			
Assignment for the	Civil Engineering: Specialisation Structura	al Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechr			
	Civil Engineering: Specialisation Coastal E			
		5 5 11 11 1		
	Civil Engineering: Specialisation Water an	nd Traffic: Elective Compulsory		

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

Course L0707: Introduction t	to tunnel construction
Тур	Lecture
Hrs/wk	1
CP	2
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14
Lecturer	Dr. 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> </ul>
Literature	Literature and sources     Vorlesung/Übung s. www.tu-harburg.de/gbt

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

Courses				
Title		Тур	Hrs/wk	СР
Examination of Materials, Structura	al Condition and Damages (L0260)	Lecture	3	4
Examination of Materials, Structura	al Condition and Damages (L0261)	Recitation Section (small)	1	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
<b>Recommended Previous</b>	Basic knowledge about building materials or m	aterial science, for example by the mo	dule Building Ma	aterials and Build
Knowledge	Chemistry.			
Educational Objectives	After taking part successfully, students have reach	ned the following learning results		
<b>Professional Competence</b>				
Knowledge	The students are able to describe the rules for tr	ading, use and marking of construction pr	oducts in Germar	ny. They know whi
	methods for the testing of building material prope	rties are usable and know the limitations a	nd characterics o	f the most import
	testing methods.			
Chille	The students are able to responsibly discover the	allos for trading and using of building prod	usta in Cormony	
SKIIIS	The students are able to responsibly discover the i			tion of domograp
	They are able to chose suitable methods for the to			
	the examination of the structural conditions of bui are able to describe an examination in form of a t		nptons to the cau	se of damages. If
Personal Competence				
Social Competence	The students can describe the different roles of r	nanufacturers as well as testing, supervise	ory and certificati	on bodies within
	framework of material testing. They can describe t	he different roles of the participants in leg	al proceedings.	
Autonomy	The students are able to make the timing and the	operation steps to learn the specialist know	vledge of a very e	extensive field.
Workload in Hours	Independent Study Time 124, Study Time in Lectu	re 56		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Enginee	ering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engi	neering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engineering	ng: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic:	Elective Compulsory		
	International Management and Engineering: Speci	alisation II. Civil Engineering: Elective Com	oulsory	
	Materials Science: Specialisation Engineering Mate	rials: Elective Compulsory		

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

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

Courses				
Title		Тур	Hrs/wk	СР
Integrated Transportation Planning	(L1068)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Carsten Gertz			
Admission Requirements				
	some knowledge of transport planning, e.g. through taking the u	undergraduate class "Transport P	lanning and Tr	affic Engineerin
Knowledge		<b>J</b>	5	5
Educational Objectives	After taking part successfully, students have reached the followi	ing learning results		
Professional Competence				
Knowledge	Students are able to:			
	<ul> <li>describe interdependencies between land-use/location ch</li> <li>explain and evaluate the casial accelerical and economic</li> </ul>			
	<ul> <li>explain and evaluate the social, ecological and economic</li> <li>relate surrent issues in the area of integrated transport of</li> </ul>			es.
	<ul> <li>relate current issues in the area of integrated transport plant</li> </ul>	ianning and formulate an opinion	on them.	
Skills	Students are able to:			
Skins				
	quantify important parameters, which influence travel der			
	<ul> <li>comprehensively examine a pre-defined or self-selected</li> </ul>	topic from a transportation studi	es perspective	and document t
	results in accordance with scientific conventions.			
Personal Competence				
Social Competence	Students are able to:			
	<ul> <li>provide feedback on topical contents and their teaching.</li> </ul>			
	<ul> <li>constructively handle feedback on their own work.</li> </ul>			
	<ul> <li>produce results in group work and document these.</li> </ul>			
Autonomy	Students are able to:			
	<ul> <li>assess potential consequences of their future professiona</li> </ul>	al activities		
	<ul> <li>independently plan working on a pre-defined project topic</li> </ul>		de and use an	propriate means
	its execution.	-,,,,	.9	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	written assignment with presentation during the semester			
scale				
•	Civil Engineering: Specialisation Structural Engineering: Elective			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elect			
	Civil Engineering: Specialisation Coastal Engineering: Elective Co	ompulsory		
	Civil Engineering: Specialisation Water and Traffic: Compulsory			
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure		ory	
	Water and Environmental Engineering: Specialisation Water: Ele			
	Water and Environmental Engineering: Specialisation Environme			
	Water and Environmental Engineering: Specialisation Cities: Cor	mpulsory		

Course L1068: Integrated Tr	ansportation Planning
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Carsten Gertz, Dr. Philine Gaffron, Jacqueline Bianca Maaß
Language	DE
Cycle	WiSe
	The course will provide students with an understanding of interdependencies between land-use and transportation. Specific topics include a.o.:    interactions between transport and the environment and consequent limitations  characteristics of integrated planning  complex planning processes  interdependencies of location choice and mobility behaviour  transport and land-use policies  project on current issues in transportation studies
Literature	Kutter, Eckhard (2005) Entwicklung innovativer Verkehrsstrategien für die mobile Gesellschaft. Erich Schmidt Verlag. Berlin. Bracher, Tilman u. a. (Hrsg.) (68. Ergänzung 2013) Handbuch der kommunalen Verkehrsplanung. Herbert Wichmann Verlag. Berlin, Offenbach. (Loseblattsammlung mit kontinuierlichen Ergänzungen)

Courses				
Title		Тур	Hrs/wk	СР
Chemistry of Drinking Water Treatn	nent (L0311)	Lecture	2	1
Chemistry of Drinking Water Treatm		Recitation Section (large)	1	2
Water Resource Management (L040	)2)	Lecture	2	2
Nater Resource Management (L040	)3)	Recitation Section (small)	1	1
Module Responsible	Prof. Mathias Ernst			
Admission Requirements	None			
<b>Recommended Previous</b>	Knowledge of water management and the	e key processes involved in water treatment.		
Knowledge				
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence				
Skills	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 at the scope of their application. Students will be able to assess complex problems in drinking water production and establish solutions involving water management and technical measures. They will be able to assess the evaluation methods that can be used for this. Students we be able to carry out chemical calculations for selected treatment processes and apply generally accepted technical rules a standards to these processes.			
Personal Competence				
Social Competence	Working in a diverse group of specialists, students will be able to develop and document complex solutions for the manageme and treatment of drinking water. They will be able to take an appropriate professional position, for example representing us interests. They will be able to develop joint solutions in teams of diverse experts and present these solutions to others.			
Autonomy	Students will be in a position to work on a subject independently and present on this subject.			
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Course achievement	None			
	Written exam			
Examination				
	60 min (chemistry) + presentation			
Examination Examination duration and scale	60 min (chemistry) + presentation			
Examination duration and scale		al Engineering: Elective Compulsory		
Examination duration and scale Assignment for the	Civil Engineering: Specialisation Structura			
Examination duration and scale	Civil Engineering: Specialisation Structura Civil Engineering: Specialisation Geotech	nical Engineering: Elective Compulsory		
Examination duration and scale Assignment for the	Civil Engineering: Specialisation Structura Civil Engineering: Specialisation Geotech Civil Engineering: Specialisation Water ar	nical Engineering: Elective Compulsory nd Traffic: Compulsory		
Examination duration and scale Assignment for the	Civil Engineering: Specialisation Structura Civil Engineering: Specialisation Geotech Civil Engineering: Specialisation Water ar Civil Engineering: Specialisation Coastal I	nical Engineering: Elective Compulsory nd Traffic: Compulsory Engineering: Elective Compulsory	ngineering. Elective	Compulsory
Examination duration and scale Assignment for the	Civil Engineering: Specialisation Structura Civil Engineering: Specialisation Geotech Civil Engineering: Specialisation Water ar Civil Engineering: Specialisation Coastal I International Management and Engineeri	nical Engineering: Elective Compulsory nd Traffic: Compulsory Engineering: Elective Compulsory ng: Specialisation II. Energy and Environmental El	ngineering: Elective	Compulsory
Examination duration and scale Assignment for the	Civil Engineering: Specialisation Structura Civil Engineering: Specialisation Geotech Civil Engineering: Specialisation Water ar Civil Engineering: Specialisation Coastal I International Management and Engineeri Water and Environmental Engineering: Sp	nical Engineering: Elective Compulsory nd Traffic: Compulsory Engineering: Elective Compulsory ng: Specialisation II. Energy and Environmental El	ngineering: Elective	Compulsory

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

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

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

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

Courses					
Title		Тур	Hrs/wk	СР	
Integrated Pollution Control (L0502)	)	Lecture	2	2	
Health, Safety and Environmental M		Lecture	2	3	
Health, Safety and Environmental M	Janagement (L0388)	Recitation Section (small)	1	1	
Module Responsible	Prof. Ralf Otterpohl				
Admission Requirements	None				
<b>Recommended Previous</b>					
Knowledge	Good knowledge in Technologies for Environn		solutions)		
	Good knowledge of the relevant Environment				
	<ul> <li>Basic knowledge of instruments for Environm</li> </ul>	ental Assessment			
Educational Objectives	After taking part successfully, students have reache	d the following learning results			
Professional Competence		5 5			
-	The students are able to describe the basics of re	egulations, economic instruments, volun	tarv initiatives. f	undamentals of	
	legislation ISO 14001, EMAS and Responsible Care				
	substance cycles and approaches from end-of-pip				
	knowledge of complex industry related problems.	They are able to judge environmental is:	sues and to wide	ly consider, apply	
	carry out innovative technical solutions, remediation	on measures and further interventions a	s well as concep	tual problem solv	
	approaches in the full range of problems in different	industrial sectors.			
Skills	Students are able to assess current problems and	situations in the field of environmental p	rotection. They c	an consider the b	
	available techniques and to plan and suggest concrete actions in a company- or branch-specific context. By this means they ca				
	solve problems on a technical, administrative and legislative level.				
Personal Competence					
Social Competence	The students can work together in international grou	ups.			
Autonomy	Students are able to organize their work flow to pro	epare themselves for presentations and	contributions to t	he discussions. T	
	can acquire appropriate knowledge by making enquiries independently.				
Workload in Hours	Independent Study Time 110, Study Time in Lecture	2 70			
Credit points					
Course achievement					
Examination					
Examination duration and					
scale					
	Civil Engineering: Specialisation Water and Traffic: E	Elective Compulsory			
Following Curricula	5 5 1	, ,	anagement and	Controlling: Elec	
· •	Compulsory	enering, recus in		controlling. Lice	
	Environmental Engineering: Core Qualification: Com	pulsory			
			er: Elective Comr	oulsorv	
	Joint European Master in Environmental Studies - Cities and Sustainability: Specialisation Water: Elective Compulsory Joint European Master in Environmental Studies - Cities and Sustainability: Specialisation Energy: Elective Compulsory				
	Joint European Master in Environmental Studies - Cit	ties and Sustainability: Specialisation Ene	ray: Elective Com	npulsorv	
		5 1	57	npulsory	
	Product Development, Materials and Production: Spe	ecialisation Product Development: Electiv	e Compulsory	ipulsory	
	Product Development, Materials and Production: Spe Product Development, Materials and Production: Spe	ecialisation Product Development: Electiv ecialisation Production: Elective Compulso	e Compulsory ory	pulsory	
	Product Development, Materials and Production: Spe Product Development, Materials and Production: Spe Product Development, Materials and Production: Spe	ecialisation Product Development: Electiv ecialisation Production: Elective Compulso ecialisation Materials: Elective Compulsor	e Compulsory ory y	npulsory	
	Product Development, Materials and Production: Spe Product Development, Materials and Production: Spe	ecialisation Product Development: Electiv ecialisation Production: Elective Compulso ecialisation Materials: Elective Compulsor Process Engineering: Elective Compulsory	e Compulsory ory y	npulsory	

ourse L0502: Integrated Pollution Control			
Тур	Lecture		
Hrs/wk			
СР	2		
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28		
Lecturer	Prof. Ralf Otterpohl		
Language	EN		
Cycle	WiSe		
Content	The lecture focusses on:  The Regulatory Framework Pollution & Impacts, Characteristics of Pollutants Approaches of Integrated Pollution Control Sevilla Process, Best Available Technologies & BREF Documents Case Studies: paper industry, cement industry, automotive industry Field Trip		
	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	y and Environmental Management
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Hans-Joachim Nau
Language	EN
Cycle	WiSe
Content	<ul> <li>Objectives of and benefit from HSE management</li> <li>From dilution and end-of-pipe technology to eco-efficiency and eco-effectiveness Behaviour control: regulations, economic instruments and voluntary initiatives</li> <li>Fundamentals of HSE legislation ISO 14001, EMAS and Responsible Care ISO 14001 requirements Environmental performance evaluation Risk management: hazard, risk and safety Health and safety at the workplace</li> <li>Crisis management</li> </ul>
Literature	C. Stephan: Industrial Health, Safety and Environmental Management, MV-Verlag, Münster, 2007/2012 (can be found in the library under GTG 315) Exercises can be downloaded from StudIP

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

Courses			
Title		Тур	Hrs/wk CP
Biological Wastewater Treatment (	L0517)	Lecture	2 3
Air Pollution Abatement (L0203)		Lecture	2 3
Module Responsible	Dr. Swantje Pietsch-Braune		
Admission Requirements	None		
<b>Recommended Previous</b>	Basic knowledge of biology and chemist	try	
Knowledge			
	Basic knowledge of solids process engir	neering and separation technology	
Educational Objectives	After taking part successfully, students	have reached the following learning results	
Professional Competence	After taking part successfully, students	have reached the following learning results	
	After successful completion of the modu	le students are able to	
Knowiedge			
	<ul> <li>name and explain biological proc</li> </ul>	esses for waste water treatment,	
	<ul> <li>characterize waste water and sev</li> </ul>		
	<ul> <li>discuss legal regulations in the a</li> </ul>		
	<ul> <li>explain the effects of air pollutan</li> </ul>		
	<ul> <li>name and explan off gas tretame</li> </ul>	ent processes and to define their area of application	ation
Skills	Students are able to		
		s for the biological waste water treatment	
	<ul> <li>combine processes for cleaning of</li> </ul>	of off-gases depending on the pollutants contai	ned in the gases
Personal Competence			
Social Competence			
Autonomy			
Workload in Hours	Independent Study Time 124, Study Tin	ne in Lecture 56	
Credit points	6		
Course achievement	None		
Examination	Written exam		
Examination duration and	90 min		
scale			
Assignment for the	Civil Engineering: Specialisation Water a	and Traffic: Elective Compulsory	
Following Curricula	Bioprocess Engineering: Specialisation	A - General Bioprocess Engineering: Elective Co	ompulsory
	Chemical and Bioprocess Engineering: S	Specialisation General Process Engineering: Ele	ctive Compulsory
	Environmental Engineering: Specialisati	on Waste and Energy: Elective Compulsory	
	International Management and Enginee	ring: Specialisation II. Energy and Environment	al Engineering: Elective Compulsory
	Joint European Master in Environmental	Studies - Cities and Sustainability: Specialisati	on Water: Elective Compulsory
	Renewable Energies: Specialisation Bioe	energy Systems: Elective Compulsory	
	Process Engineering: Specialisation Env	ironmental Process Engineering: Elective Comp	bulsory
	Process Engineering: Specialisation Proc		
	5 5	Specialisation Water: Elective Compulsory	
	5 5	Specialisation Environment: Compulsory	
	Water and Environmental Engineering:	Specialisation Cities: Compulsory	

-	stewater Treatment
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Dr. Joachim Behrendt
Language	DE/EN
Cycle	WiSe
Content	Charaterisation of Wastewater
	Metobolism of Microorganisms
	Kinetic of mirobiotic processes
	Calculation of bioreactor for wastewater treatment
	Concepts of Wastewater treatment
	Design of WWTP
	Excursion to a WWTP
	Biofilms
	Biofim Reactors
	Anaerobic Wastewater and sldge treatment
	resources oriented sanitation technology
	Future challenges of wastewater treatment

	1
Literature	Gujer, Willi
	Siedlungswasserwirtschaft : mit 84 Tabellen
	ISBN: 3540343296 (Gb.) URL: http://www.gbv.de/dms/bs/toc/516261924.pdf URL: http://deposit.d-nb.de/cgi-bin/dokserv?
	id=2842122&prov=M&dok_var=1&dok_ext=htm
	Berlin [u.a.] : Springer, 2007
	TUB_HH_Katalog
	Henze, Mogens
	Wastewater treatment : biological and chemical processes
	ISBN: 3540422285 (Pp.)
	Berlin [u.a.] : Springer, 2002
	TUB_HH Katalog
	Imhoff, Karl (Imhoff, Klaus R.;)
	Taschenbuch der Stadtentwässerung : mit 10 Tafeln
	ISBN: 3486263331 ((Gb.))
	München [u.a.] : Oldenbourg, 1999
	TUB_HH_Katalog
	Lange, Jörg (Otterpohl, Ralf; Steger-Hartmann, Thomas;)
	Abwasser : Handbuch zu einer zukunftsfähigen Wasserwirtschaft
	ISBN: 3980350215 (kart.) URL: http://www.gbv.de/du/services/agi/52567E5D44DA0809C12570220050BF25/000000700334
	Donaueschingen-Pfohren : Mall-Beton-Verl., 2000
	TUB_HH_Katalog
	Mudrack, Klaus (Kunst, Sabine;)
	Biologie der Abwasserreinigung : 18 Tabellen
	ISBN: 382741427X URL: http://www.gbv.de/du/services/agi/94B581161B6EC747C1256E3F005A8143/420000114903
	Heidelberg [u.a.] : Spektrum, Akad. Verl., 2003
	TUB_HH_Katalog
	Tchobanoglous, George (Metcalf & Eddy, Inc., ;)
	Wastewater engineering : treatment and reuse
	ISBN: 0070418780 (alk. paper) ISBN: 0071122508 (ISE (*pbk))
	Boston [u.a.] : McGraw-Hill, 2003
	TUB_HH_Katalog
	Henze, Mogens
	Activated sludge models ASM1, ASM2, ASM2d and ASM3
	ISBN: 1900222248
	London : IWA Publ., 2002
	TUB_HH_Katalog
	Kunz, Peter
	Umwelt-Bioverfahrenstechnik
	Vieweg, 1992
	Bauhaus-Universität., Arbeitsgruppe Weiterbildendes Studium Wasser und Umwelt (Deutsche Vereinigung für
	Wasserwirtschaft, Abwasser und Abfall, ;)
	Abwasserbehandlung : Gewässerbelastung, Bemessungsgrundlagen, Mechanische Verfahren, Biologische Verfahren, Reststoffe
	aus der Abwasserbehandlung, Kleinkläranlagen
	ISBN: 3860682725 URL: http://www.gbv.de/dms/weimar/toc/513989765_toc.pdf URL:
	http://www.gbv.de/dms/weimar/abs/513989765_abs.pdf
	Weimar : Universitätsverl, 2006
	TUB_HH_Katalog
	Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall
	DWA-Regelwerk
	Hennef : DWA, 2004
	TUB_HH_Katalog
	Wiesmann, Udo (Choi, In Su; Dombrowski, Eva-Maria;)
	Fundamentals of biological wastewater treatment
	ISBN: 3527312196 (Gb.) URL: http://deposit.ddb.de/cgi-bin/dokserv?id=2774611&prov=M&dok_var=1&dok_ext=htm
	Weinheim : WILEY-VCH, 2007
	TUB_HH_Katalog

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

Courses				
Title		Тур	Hrs/wk	СР
Biology (L1428)		Lecture	2	2
Geology and Soil Science (L0903)		Lecture	2	1
Environmental Analysis (L0354)		Lecture	2	3
	Dr. Dorothea Rechtenbach			
Admission Requirements				
	Fundamentals of inorganic/organic	chemistry and biology (knowledge acquired at scho	ool)	
Knowledge				
Educational Objectives	After taking part successfully, stude	ents have reached the following learning results		
Professional Competence				
Knowledge	With the completion of this module students acquire profound knowledge of the geo- and pedosphere, biogeochemical proce			eochemical proces
	and the fate of migrating compound	ds in soil and groundwater. They learn about metho	ods to investigate sites f	or different use.
Skills	With the completion of this module students can apply the acquired theoretical knowledge to model sites and assess the technically and conceptually. They are able to draw comparisons on different investigation strategies and technique		d assess the situa	
	projects can be devised and treated	•	5	
Personal Competence				
	Students can discuss technical and	scientific tasks within a seminar subject specific ar	nd interdisciplinary	
Social competence	Students can discuss technical and	scientific tasks within a seminar subject specific a	ia interaiscipiinary .	
Autonomy	Students can independently exploit	sources , acquire the particular knowledge of the s	subject and apply it to n	ew problems.
Workload in Hours	Independent Study Time 96, Study	Time in Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	2 Std. 15 Min.			
scale				
Assignment for the	Civil Engineering: Specialisation Wa	ater and Traffic: Elective Compulsory		
Following Curricula	Water and Environmental Engineer	inn Com Ourlifienting Commulate		

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

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

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

Figure Fights	truction and Simulation of S			
Courses				
Title		Тур	Hrs/wk	СР
Construction and renovation of urb	an sewer systems (L1998)	Seminar	3	3
Simulation of sewerage systems (L	2006)	Seminar	3	3
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge		wers		
	Mechanics			
	Soil mechanics and foundation en	• •		
	<ul> <li>Knowledge about urban sewerage</li> </ul>	systems and water management		
Educational Objectives	After taking part successfully, students h	nave reached the following learning results		
Professional Competence				
Knowledge	Students can describe urban wastewater	r systems by means of software-based modeli	ing. In case studies they	can perform syste
	and weak point analyzes. In addition, the	ey can analyze the hydraulic effects quantitati	ively. Furthermore, they	have the knowled
	to comprehend flow events in gravity-set	wers based on the St. Venant equations.		
	-	structural requirements of the sewer system.	. Cases of damage are	investigated and t
	knowledge regarding different renovation	n technologies for sewer systems is acquired.		
Skills	The students can simulate different run	off events in sewer systems and are able to	o dimension the sewer	systems according
		onstruction materials and static requirements		
Personal Competence				
Social Competence	Students are able to apply the acquired s	skills in a team and can impart this knowledge	2.	
Autonomy	Students can solve problems in the fi	ield of wastewater systems independently,	concerning in particula	ar dimensioning a
hatohomy		re, they are able to present and justify their so	•	an annensioning a
Workload in Hours	Independent Study Time 96, Study Time	in Lecture 84		
Credit points	6			
Course achievement	Compulsory Bonus Form	Description		
	No 20 % Presentation			
	Written elaboration			
Examination duration and	nach Absprache			
scale				
-	Civil Engineering: Specialisation Water and			
Following Curricula	Water and Environmental Engineering: S	pecialisation Water: Compulsory		
	Water and Environmental Engineering: S	pecialisation Environment: Elective Compulso	ry	

Course L1998: Construction	and renovation of urban sewer systems	
Тур	Seminar	
Hrs/wk		
CP		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Lecturer	Prof. Ingo Weidlich	
Language		
Cycle	WiSe	
Content	The lecture focusses on construction and renovation of urban se	wer pipelines.
	Construction:	
	• Dine materials, types and joint technology	
	<ul> <li>Pipe materials, types and joint technology</li> <li>Open trenches</li> </ul>	
	Trenchless technologies	
	Pipe Statics:	
	<ul> <li>Design of sewers according to ATV A 127</li> </ul>	
	Earth pressure on pipes, pipe deformation, cutting forces	
	Comparison with other international calculation approach	es
	Renovation:	
	Renovation.	
	Failure case study	
	Overview on the different renovation technologies	
	Liner design according to DWA-A 143	
Literature	Nr.	Titel
	1	ATV A 127, Abwassertechnische Vereinigung e.V., Arbeitsblatt A
		127, Regelwerk Abwasser-Abfall, Vertrieb: GFA, DK 628.22
		(083),A 127, 2000
	2	DIN EN 1610, Verlegung und Prüfung von Abwasserleitungen und
		-kanälen, Beuth Verlag, Berlin, 1997
	3	Arbeitsblatt DWA-A 143-1, Sanierung von
		Entwässerungssystemen außerhalb von Gebäuden, Teil 1:
		Planung und Überwachung von Sanierungsmaßnahmen Februar 2015
	4	Arbeitsblatt DWA-A 143-2, Sanierung von
		Entwässerungssystemen außerhalb von Gebäuden Teil 2:
		Statische Berechnung zur Sanierung von Abwasserleitungen und
		-kanälen mit Lining und Montageverfahren, Juli 2015
	5	DIN EN 752:2008, 2008: Entwässerungssysteme außerhalb von
		Gebäuden - Kanalmanagement.
	6	Zeitschrift 3R, Fachzeitschrift für sichere und effiziente
	-	Rohrleitungssysteme
	7	Handbuch für den Rohrleitungsbau Band 1 und 2, 4. Auflage,
	8	Günter Wossog, 2015 Rohrleitungstechnik, Walter Wagner, Vogel Buchverlag, 2006
	9	Stein D., Stein R., "Instandhaltung von Kanalisationen", 1008 S.,
		ISBN 978-3-9810648-4-1   Verlag Prof. DrIng. Stein & Partner
		GmbH, 2014
	10	Stein, D., "Grabenloser Leitungsbau", 1. Auflage, Gebundene
		Ausgabe - 1166 Seiten, Ernst & Sohn Verlag, 2003, ISBN:
		3433017786
	11	Willoughby D:A: "Horizontal Directional Drilling: Utility and
		Pipeline Applications" Digital Engineering Library @ McGraw-Hill -
		The McGraw-Hill Companies, Inc., 2005
	12	Weidlich I., "Erddruck auf Rohre", 1. Auflage, ISBN 3-89999-027-
		7, 227 Seiten, 2012

Course L2006: Simulation of	ourse L2006: Simulation of sewerage systems		
Тур	Seminar		
Hrs/wk	3		
СР	3		
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42		
Lecturer	Prof. Ralf Otterpohl		
Language	EN		
Cycle	WiSe		
Content	<ul> <li>Modeling of sewer systems:</li> <li>Modeling approaches in wastewater management, especially approaches to integrated modeling</li> <li>Planning processes, calculations and design approaches for elements of gravity-sewers</li> <li>Model setup</li> <li>St. Venant equation and simplifications of models (kinematic wave etc.)</li> <li>Calculation &amp; modeling of solids transport (advection, diffusion, dispersion and sales processes)</li> <li>Examples for modeling with SWMM (EPA, USA)</li> </ul>		
Literature			

Module M0874: Waste	ewater Systems			
Courses				
Title		Тур	Hrs/wk	СР
Wastewater Systems - Collection, T	reatment and Reuse (10934)	Lecture	2	2
Wastewater Systems - Collection, T		Recitation Section (large)	1	1
Advanced Wastewater Treatment (	L0357)	Lecture	2	2
Advanced Wastewater Treatment (	_0358)	Recitation Section (large)	1	1
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
<b>Recommended Previous</b>	Knowledge of wastewater management and	d the key processes involved in wastewater trea	tment.	
Knowledge				
Educational Objectives	After taking part successfully, students hav	e reached the following learning results		
Professional Competence				
Knowledge	Students are able to outline key areas of th	ne full range of treatment systems in waste wat	er management, as	s well as their mut
	dependence for sustainable water protectio	on. They can describe relevant economic, enviro	nmental 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	t plants.		
Personal Competence				
	Social skills are not targeted in this module.			
boeiar competence				
Autonomy	y Students are in a position to work on a subject and to organize their work flow independently. They can also present of			also present on t
	subject.			
Workload in Hours	Independent Study Time 96, Study Time in	Lecture 84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural I	Engineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnic	cal Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Eng	gineering: Elective Compulsory		
	Civil Engineering: Specialisation Water and	Traffic: Compulsory		
	Bioprocess Engineering: Specialisation A - C	General Bioprocess Engineering: Elective Compu	llsory	
	Environmental Engineering: Specialisation V	Water: Elective Compulsory		
	International Management and Engineering	: Specialisation II. Process Engineering and Biot	echnology: Elective	Compulsory
	International Management and Engineering	: Specialisation II. Energy and Environmental Er	gineering: Elective	Compulsory
	Process Engineering: Specialisation Environ	mental Process Engineering: Elective Compulso	ry	
	Process Engineering: Specialisation Process	s Engineering: Elective Compulsory		
	Water and Environmental Engineering: Spec	cialisation Water: Compulsory		
	Water and Environmental Engineering: Spe	cialisation Environment: Elective Compulsory		

## Course L0934: Wastewater Systems - Collection, Treatment and Reuse

Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Ralf Otterpohl
Language	EN
Cycle	SoSe
Content	•Understanding the global situation with water and wastewater
	•Regional planning and decentralised systems
	•Overview on innovative approaches
	•In depth knowledge on advanced wastewater treatment options for different situations, for end-of-pipe and reuse
	Mathematical Modelling of Nitrogen Removal
	•Exercises with calculations and design
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 S	Irse L0943: Wastewater Systems - Collection, Treatment and Reuse		
Тур	Recitation Section (large)		
Hrs/wk	1		
СР	1		
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14		
Lecturer	Prof. Ralf Otterpohl		
Language	EN		
Cycle	SoSe		
Content	See interlocking course		
Literature	See interlocking course		

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

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

Courses				
Title		Тур	Hrs/wk	СР
Noise Protection (L1109)		Lecture	2	2
Urban Infrastructures (L0874)		Project-/problem-based Learning	2	4
Module Responsible	Dr. Dorothea Rechtenbach			
Admission Requirements	None			
<b>Recommended Previous</b>	. Kasuladas as likas slavning			
Knowledge	Knowledge on Urban planning     Knowledge on measures for climate protection			
	<ul> <li>Knowledge on measures for climate protection</li> <li>General knowledge of scientific writing/working</li> </ul>			
	General knowledge of sciencific writing/working			
Educational Objectives	After taking part successfully, students have reached the following	ng learning results		
Professional Competence				
Knowledge	Students can describe urban development corridors as well as c	urrent and future urban environr	mental probler	ms. They are able
	explain the causes of environmental problems (like noise).			
	Students can specify applications for various technical innovatio		bute to the im	provement of urb
	life. They can, for example, derive and discuss measures for effective noise abatement.			
Skills	Skills Students are able to develop specific solutions for correcting existing or future environment-related prob		problems of urb	
development. They can define a range of conceptual and technical solutions for environmental problems for diffi				
	paths. To solve specific urban environmental problems they ca	n select technical innovations a	nd integrate t	hem into the urb
	context.			
Personal Competence				
Social Competence	The students can work together in international groups.			
Autonomu	Chudents are able to erganize their work flow to prepare theme	alves for presentations and cont	ributions to th	a discussions. Th
Autonomy	ny Students are able to organize their work flow to prepare themselves for presentations and contributions to the discussions			le discussions. In
	can acquire appropriate knowledge by making enquiries indepen	identiy.		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points	6			
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Written Report plus oral Presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective	Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Election	ive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective Co	mpulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Com			
	Environmental Engineering: Core Qualification: Elective Compuls	•		
	Joint European Master in Environmental Studies - Cities and Sust			
	Logistics, Infrastructure and Mobility: Specialisation Infrastructur		ory	
	Water and Environmental Engineering: Specialisation Environme	nt: Elective Compulsory		
	Water and Environmental Engineering: Specialisation Environmental			

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

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

Courses					
Title		Тур	Hrs/wk	СР	
Applied Surface Hydrology (L0289)		Lecture	2	2	
Applied Surface Hydrology (L1412)		Project-/problem-based Learning	1	2	
Interaction Water - Environment in		Project-/problem-based Learning	1	2	
Module Responsible					
Admission Requirements					
	Fundamentals of Hydromechanics and Hydraulic Engineering: Hydraulic Engineering I and Hydraulic Engineering II				
Knowledge					
	After taking part successfully, students have r	eached the following learning results			
Professional Competence					
Knowledge		cepts of hydrology and water management. They			
	the relevant processes of the hydrological water cycle. Besides, the students know the main aspects of rainfall-run-off-models an				
	are able to theoretically derive established re	servoir / storage models and a unit-hydrograph.			
Skills	The students are able to use the basic hydr	ological concepts and approaches and are able t	o theoreticall	y derive establis	
	reservoir / storage models or a unit-hydrograph as the basis for rainfall-run-off-models. The student are able to explain the bas				
	concepts of measurements of hydrological and hydrodynamic values in nature and are able to perform, analyze and statistical				
assess these measurements. Furthermore, they are able to apply a hydrological model to basic hydrological model hydrological mod			ydrological problems.		
Personal Competence					
-	The students are able to deploy their gained knowledge in applied problems of the hydrology and water management. Additior			gement. Addition	
	they will be able to work in team with engineers of other disciplines.		J		
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 L	ecture 56			
Credit points	6				
Course achievement	None				
	Written exam				
	The duration of the examination is 90 min. The examination includes tasks with respect to the general understanding of the lecture				
scale	e contents and calculations tasks.				
Assignment for the	Civil Engineering: Specialisation Water and Tr	affic: Elective Compulsory			
Following Curricula	Environmental Engineering: Core Qualification: Elective Compulsory				
	Joint European Master in Environmental Studies - Cities and Sustainability: Core Qualification: Compulsory				
	Water and Environmental Engineering: Specia				
	Water and Environmental Engineering: Specia				
	Water and Environmental Engineering: Specia	lisation Cities: Elective Compulsory			

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
	nergy, Soil and Food Nexus (L1229)	Seminar	2	2
Water & Wastewater Systems in a	stewater Systems in a Global Context (L0939) Lecture 2 4			4
Module Responsible	Prof. Ralf Otterpohl			
Admission Requirements	None			
<b>Recommended Previous</b>	Basic knowledge of the global situation wi	th rising poverty, soil degradation, mig	ration to cities, lack of	water resources a
Knowledge	sanitation			
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence		· · · · · · · · · · · · · · · · · ·		
-	Students can describe the facets of the globa	al water situation. Students can iudge the	e enormous potential of t	ne implementation
	synergistic systems in Water, Soil, Food and			
Skills	Students are able to design ecological settlements for different geographic and socio-economic conditions for the main climates			
	around the world.			
Personal Competence				
	The students are able to develop a specific topic in a team and to work out milestones according to a given plan.			
,				
Autonomy	Students are in a position to work on a subject and to organize their work flow independently. They can also present on			
	subject.			
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	During the course of the semester, the students work towards mile stones. The work includes presentations and papers. Deta		and papers. Detail	
scale	information can be found at the beginning of	the smester in the StudIP course module	e handbook.	
Assignment for the	Civil Engineering: Specialisation Water and T	raffic: Elective Compulsory		
Following Curricula	Bioprocess Engineering: Specialisation A - Ge	eneral Bioprocess Engineering: Elective C	Compulsory	
	Chemical and Bioprocess Engineering: Specialisation General Process Engineering: Elective Compulsory			
	Environmental Engineering: Core Qualification	n: Elective Compulsory		
	Joint European Master in Environmental Stud	ies - Cities and Sustainability: Core Quali	fication: Compulsory	
	Process Engineering: Specialisation Environm	nental Process Engineering: Elective Com	ipulsory	
	Process Engineering: Specialisation Process	Engineering: Elective Compulsory		
	Water and Environmental Engineering: Spec	alisation Water: Elective Compulsory		
	Water and Environmental Engineering: Spec	alisation Environment: Elective Compulse	ory	
	Water and Environmental Engineering: Spec	alisation Cities: Elective Compulsory		

Course L1229: Ecological Tov	wn Design - Water, Energy, Soil and Food Nexus			
Тур	Seminar			
Hrs/wk	2			
СР	2			
Workload in Hours	lependent Study Time 32, Study Time in Lecture 28			
Lecturer	of. 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	
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28	
Lecturer	Prof. Ralf Otterpohl	
Language	EN	
Cycle	SoSe	
Content	<ul> <li>Keynote lecture and video</li> <li>Water &amp; Soil: Water availability as a consequence of healthy soils</li> <li>Water and it's utilization, Integrated Urban Water Management</li> <li>Water &amp; Energy, lecture and panel discussion pro and con for a specific big dam project</li> <li>Rainwater Harvesting on Catchment level, Holistic Planned Grazing, Multi-Use-Reforestation</li> <li>Sanitation and Reuse of water, nutrients and soil conditioners, Conventional and Innovative Approaches</li> <li>Why are there excreta in water? Public Health, Awareness Campaigns</li> <li>Rehearsal session, Q&amp;A</li> </ul>	
Literature	<ul> <li>Montgomery, David R. 2007: Dirt: The Erosion of Civilizations, University of California Press</li> <li>Liu, John D.: http://eempc.org/hope-in-a-changing_climate/ (Integrated regeneration of the Loess Plateau, China, and sites in Ethiopia and Rwanda)</li> <li>http://youtu.be/9hmkgn0nBgk (Miracle Water Village, India, Integrated Rainwater Harvesting, Water Efficiency, Reforestation and Sanitation)</li> </ul>	

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

Course L1066: City Planning	
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Carsten Gertz
Language	DE
Cycle	SoSe
Content	"Principles of Urban Planning" deals with the determinants of urban development and their interactions. Topics include:
	<ul> <li>legal framework,</li> <li>instruments and methods of planning,</li> <li>functional requirements,</li> <li>stakeholders and actors</li> <li>basic design requirements</li> <li>different planning levels and</li> <li>historical contexts.</li> </ul> The objective of the course is for students to acquire a basic understanding of urban development problems and approaches for solving them. They will also be able to comprehend the process of urban planning. The course also covers the various functional and aesthetic requirements for designing streetscape as the most important elements of public space. The project work deals with a real life scenario and includes drawing up a development plan, an urban design concept, a building masterplan and a street redesign.
Literature	Albers, Gerd; Wekel, Julian (2009) Stadtplanung: Eine illustrierte Einführung. Primus Verlag. Darmstadt. Frick, Dieter (2008) Theorie des Städtebaus: Zur baulich-räumlichen Organisation von Stadt. Wasmuth-Verlag. Tübingen Jonas, Carsten (2009) Die Stadt und ihr Grundriss. Wasmuth-Verlag. Tübingen Kostof, Spiro; Castillo, Greg (1998) Die Anatomie der Stadt. Geschichte städtischer Strukturen. Campus-Verlag. Frankfurt/New York.

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

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

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

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

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

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

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

Course L2732: Vadose Zone	Hydrology
Тур	Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Nima Shokri
Language	EN
Cycle	SoSe
Content	
Literature	

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

-				
Courses				
Title		Тур	Hrs/wk	СР
Advanced Modeling Techniques for Multiphase Flow in Porous Media (L2738)		Recitation Section (small)	2	2
Fundamentals of Multiphase Flow ir Fundamentals of Multiphase Flow ir		Lecture Recitation Section (large)	2	2
Module Responsible		Rectation Section (large)	2	2
Admission Requirements				
Recommended Previous				
Knowledge				
Educational Objectives	After taking part successfully, students have reached	I the following learning results		
Professional Competence				
Knowledge				
Skills				
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 8	4		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	90 min			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Traffic: E	ective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine	ering: Elective Compulsory		
	Civil Engineering: Specialisation Geotechnical Engine	ering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Traffic: E	ective Compulsory		
	Environmental Engineering: Specialisation Water: Ele	ctive Compulsory		
	Environmental Engineering: Specialisation Water: Ele			
	Water and Environmental Engineering: Specialisation			
	Water and Environmental Engineering: Specialisation			
	Water and Environmental Engineering: Specialisation			
	Water and Environmental Engineering: Specialisation			
	Water and Environmental Engineering: Specialisation Water and Environmental Engineering: Specialisation			

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

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

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

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

Course L2754: Water and Environment: Application and Field Work		
Тур	Project-/problem-based Learning	
Hrs/wk	3	
СР	4	
Workload in Hours	Independent Study Time 78, Study Time in Lecture 42	
Lecturer	Anna Luisa Hemshorn de Sánchez, Dr. Salome Shokri-Kuehni	
Language	EN	
Cycle	SoSe	
Content		
Literature		

Course L2753: Water and Environment: Theory		
Тур	Lecture	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Nima Shokri	
Language	EN	
Cycle	SoSe	
Content		
Literature		

Courses							
Title	Тур	1	Hrs/wk	СР			
Construction Logistics (L1163)	Lectu		1	2			
Construction Logistics (L1164)		tation Section (small)	1	2			
Project Development and Management (L1161) Project Development and Management (L1162)		ure ect-/problem-based Learning	1	1			
		ect-/problem-based Learning	I	1			
Module Responsible	-						
Admission Requirements							
Recommended Previous							
Knowledge							
Educational Objectives	After taking part successfully, students have reached the following lea	arning results					
Professional Competence							
Knowledge	Students can						
	<ul> <li>give definitions of the main terms of construction logistics and project development and management</li> </ul>						
	<ul> <li>name advantages and disadvantages of internal or external construction logistics</li> </ul>						
	explain characteristics of products, demand and production of construction objects and their consequences for constructio						
	specific supply chains						
	differentiate constructions logistics from other logistics systems						
CL ///-							
SKIIIS	Students can						
	<ul> <li>carry out project life cycle assessments</li> </ul>						
	<ul> <li>apply methods and instruments of construction logistics</li> </ul>						
	apply methods and instruments of project development and ma	anagement					
	<ul> <li>apply methods and instruments of project development and management</li> </ul>						
	<ul> <li>design supply and waste removal concepts for a construction project</li> </ul>						
Personal Competence							
Social Competence	Students can						
	<ul> <li>hold presentations in and for groups</li> </ul>						
	<ul> <li>apply methods of conflict solving skills in group work and case studies</li> </ul>						
Autonomy	Students can						
	<ul> <li>solve problems by holistic, systemic and flow oriented thinking</li> </ul>						
	<ul> <li>improve their creativity, negotiation skills, conflict and crises solution skills by applying methods of moderation in ca</li> </ul>						
	studies						
	Independent Study Time 124, Study Time in Lecture 56						
Credit points							
Course achievement							
Examination							
	Two written papers with presentations						
scale							
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory						
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory						
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory						
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory						
	International Management and Engineering: Specialisation II. Civil Engineering: Elective Compulsory						
	International Management and Engineering: Specialisation II. Logistics: Elective Compulsory						
	Logistics, Infrastructure and Mobility: Specialisation Production and Lo	gistics: Elective Compulsory	/				
	Logistics, Infrastructure and Mobility: Specialisation Infrastructure and	d Mobility: Elective Compulso	orv				

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

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

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

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

## Module M0593: Building Materials and Building Preservation

Courses						
<b>Fitle</b>				Тур	Hrs/wk	СР
Repair of Structures (L0255)				Lecture	1	1
Mineral Building Materials (L0253)				Lecture	2	2
Technology of mineral Building Mat	erials (L0256)			Project-/problem-based Learning	1	2
Transport Processes in Building Mat	erials and Damage Processes (L	0254)		Lecture	1	1
Module Responsible	Prof. Frank Schmidt-Döhl					
Admission Requirements	None					
<b>Recommended Previous</b>	Basic knowledge about building materials, building physics and building chemistry, for example by the modules Principles of					
Knowledge	Building Materials and Buildir	ng Physics and Bu	uilding Materials an	d Building Chemistry.		
Educational Objectives	After taking part successfully	, students have r	eached the following	ng learning results		
Professional Competence						
Knowledge	manufacture of special miner able to describe the manufac	ral building mater cture, properties a	ials. They are able and fields of applic	lding materials and their function to show the characteristics of n ation of special mortars and spe s of anchor technology and desi	nineral buildin cial concretes	g materials. They
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 repart 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 th other students. In a critical discussion they defend and adjust their results. The students are able to manufacture their speci building material on the basis of this feedback.					
Autonomy	The students are able to responsibly use the resources of materials and lab equipment for their project and to investigate and to get missing components.					
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70					
Credit points	6					
Course achievement		ct theoretical cal work	Description and			
Examination	Written exam					
Examination duration and scale	120 min					
	Civil Engineering: Specialisat	ion Geotechnical	Engineering: Com	ulsory		
Following Curricula			• • •			
ronowing curricula	Civil Engineering: Specialisat Civil Engineering: Specialisat					
	civil Engineering: Specialisat	ion sciuctural Eng	gineering. Elective	compulsory		
	s Engineering. Specialisat	.o or accurat Eng	June of the second	cop 0.001 y		

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

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

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

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

	cs and Dynamics of Structure			
Courses				
Title		Тур	Hrs/wk	СР
Structural Dynamics (L1202)		Lecture	2	2
Structural Dynamics (L1203)		Recitation Section (large)	2	2
Fracture mechanics and fatigue in	steel structures (L0564)	Lecture	1	1
Fracture mechanics and fatigue in	steel structures (L0565)	Recitation Section (large)	1	1
Module Responsible	Prof. Uwe Starossek			
Admission Requirements	None			
<b>Recommended Previous</b>	Knowledge of linear structural analysis	of statically determinate and indeterminate structu	ires; Mechanics	I/II, Mathematics
Knowledge	Differential equations I			
Educational Objectives	After taking part successfully, students h	ave reached the following learning results		
Professional Competence	2			
Knowledge	After successful completion of this mod	ule, the student can explain the basic aspects of dy	namic effects o	on structures and t
	respective methods.			
<i></i>			<i>.</i>	
Skills		dule, the students will be able to predict the resp	ponse of materi	ial and structures
	dynamics loading using the appropriate of	computational approaches and methods.		
Personal Competence	2			
Social Competence	Students can			
Social Competence				
Social Competence	• participate in subject-specific and			
Social Competence				
Social Competence	• participate in subject-specific and	ront of others		
Social Competence	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific development</li> </ul>	ront of others		
	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and action</li> </ul>	ont of others at of colleagues ccept professional constructive criticism		
	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> </ul>	ont of others nt of colleagues ccept professional constructive criticism he subject area from given and other sources and ap	oply it to new pro	oblems. Furthermo
	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> </ul>	ont of others at of colleagues ccept professional constructive criticism	oply it to new pro	oblems. Furthermc
Autonomy	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> </ul>	ont of others nt of colleagues ccept professional constructive criticism the subject area from given and other sources and ap ocess for problems in the area of Structural Analysis.	oply it to new pro	oblems. Furthermc
Autonomy Workload in Hours	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> <li>they are able to structure the solution pro-</li> <li>Independent Study Time 96, Study Time</li> </ul>	ont of others nt of colleagues ccept professional constructive criticism the subject area from given and other sources and ap ocess for problems in the area of Structural Analysis.	oply it to new pro	oblems. Furthermo
Autonomy Workload in Hours Credit points	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> <li>they are able to structure the solution pro</li> <li>Independent Study Time 96, Study Time</li> <li>6</li> </ul>	ont of others nt of colleagues ccept professional constructive criticism the subject area from given and other sources and ap ocess for problems in the area of Structural Analysis.	oply it to new pro	oblems. Furthermo
Autonomy Workload in Hours Credit points Course achievement	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> <li>they are able to structure the solution pr</li> <li>Independent Study Time 96, Study Time</li> <li>6</li> <li>None</li> </ul>	ont of others nt of colleagues ccept professional constructive criticism the subject area from given and other sources and ap ocess for problems in the area of Structural Analysis.	oply it to new pro	oblems. Furthermo
Autonomy Workload in Hours Credit points Course achievement Examination	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and act</li> <li>Students are able to gain knowledge of t</li> <li>they are able to structure the solution prior</li> <li>Independent Study Time 96, Study Time</li> <li>6</li> <li>None</li> <li>Written exam</li> </ul>	ont of others nt of colleagues ccept professional constructive criticism the subject area from given and other sources and ap ocess for problems in the area of Structural Analysis.	oply it to new pro	oblems. Furthermo
Autonomy Workload in Hours Credit points Course achievement	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and act</li> <li>Students are able to gain knowledge of t</li> <li>they are able to structure the solution prior</li> <li>Independent Study Time 96, Study Time</li> <li>6</li> <li>None</li> <li>Written exam</li> </ul>	ont of others nt of colleagues ccept professional constructive criticism the subject area from given and other sources and ap ocess for problems in the area of Structural Analysis.	oply it to new pro	oblems. Furthermo
Autonomy Workload in Hours Credit points Course achievement Examination	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> <li>they are able to structure the solution prior</li> <li>Independent Study Time 96, Study Time</li> <li>6</li> <li>None</li> <li>Written exam</li> <li>150 min</li> </ul>	ont of others nt of colleagues ccept professional constructive criticism the subject area from given and other sources and ap ocess for problems in the area of Structural Analysis.	oply it to new pro	oblems. Furthermo
Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> <li>they are able to structure the solution prior</li> <li>Independent Study Time 96, Study Time</li> <li>6</li> <li>None</li> <li>Written exam</li> <li>150 min</li> </ul>	ont of others at of colleagues scept professional constructive criticism the subject area from given and other sources and ap ocess for problems in the area of Structural Analysis. in Lecture 84	oply it to new pro	oblems. Furthermo
Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> <li>they are able to structure the solution provide the solution prov</li></ul>	ont of others nt of colleagues scept professional constructive criticism the subject area from given and other sources and ap ocess for problems in the area of Structural Analysis. in Lecture 84 al Engineering: Compulsory	oply it to new pro	oblems. Furthermo
Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> <li>they are able to structure the solution provide the solution prov</li></ul>	ont of others at of colleagues scept professional constructive criticism the subject area from given and other sources and ap ocess for problems in the area of Structural Analysis. in Lecture 84 al Engineering: Compulsory nical Engineering: Elective Compulsory	oply it to new pro	oblems. Furthermo
Autonomy Workload in Hours Credit points Course achievement Examination Examination duration and scale Assignment for the	<ul> <li>participate in subject-specific and</li> <li>defend their own work results in fr</li> <li>promote the scientific developmer</li> <li>Furthermore, they can give and ac</li> <li>Students are able to gain knowledge of t</li> <li>they are able to structure the solution pro-</li> <li>Independent Study Time 96, Study Time</li> <li>6</li> <li>None</li> <li>Written exam</li> <li>150 min</li> <li>Civil Engineering: Specialisation Structure</li> </ul>	ont of others It of colleagues It of colleague	oply it to new pro	oblems. Furthermo

Course L1202: Structural Dy	namics
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Uwe Starossek
Language	DE
Cycle	SoSe
Content	<ul> <li>Single-degree-of-freedom systems: undamped and damped vibration, free vibration, forced vibrations due to harmonic, periodical or arbitrary loading, natural frequency, damping</li> <li>vibration isolation</li> <li>solution in the frequency-domain (Fourier transformation), solution in the time-domain</li> <li>multi-degree-of-freedom systems: continuous or discrete systems, modelling with finite elements, generalisation</li> <li>modal analysis</li> <li>power iteration according to v.Mises</li> <li>earthquake loading: seismological basics, response spectrum method</li> <li>wind-induced vibrations: engineering meteorology, aerodynamic, classification of excitation mechanisms</li> </ul>
Literature	Clough, R.W., Penzien, J.: Dynamics of Structures. 2. Aufl., McGraw-Hill, New York, 1993.

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

Тур	Lecture
Hrs/wk	
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Dr. Jürgen Priebe
Language	DE
Cycle	SoSe
Content	<ul> <li>basics of fatigue stress and fatigue resistance and determination of fatigue strength,</li> </ul>
	determination and use of S-N-curves and classification of notch effects,
	• set up of determination of fatigue strength under dynamic load using the accumulation formula by Palmgren-Miner,
	<ul> <li>set up of determination of fatigue strength in different examples,</li> </ul>
	<ul> <li>basics of construction and design regarding the problem of material fatigue,</li> </ul>
	<ul> <li>basics of linear elastic fracture mechanics under static and dynamic load,</li> </ul>
	determination of lifetime of steel construction based on linear elastic fracture mechanics in different examples.
Literature	Seeßelberg, C.; Kranbahnen - Bemessung und konstruktive Gestaltung; 3. Auflage; Bauwerk-Verlag; Berlin 2009
	Kuhlmann, Dürr, Günther; Kranbahnen und Betriebsfestigkeit; in Stahlbau Kalender 2003; Verlag Ernst & Sohn; Berlin 2003
	Deutscher Stahlbau-Verband (Hrsg.); Stahlbau Handbuch Band 1 Teil B; 3. Auflage; Stahlbau-Verlagsgesellschaft; Köln 1996
	Petersen, C.; Stahlbau; 3. überarb. und erw. Auflage; Vieweg-Verlag; Braunschweig 1993
	<ul> <li>DIN V ENV 1993-1-1: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 1-1: Allgemeine Bemessungsreg</li> <li>Bemessungsregeln f         ür den Hochbau; 1993</li> </ul>
	• DIN V ENV 1993-6: Eurocode 3; Bemessung und Konstruktion von Stahlbauwerken; Teil 6: Kranbahnen; 2001
	• DIN-Fachbericht 126. Richtlinie zur Anwendung von DIN V ENV 1993-6; Nationales Anwendungsdokument (NAD); Berlin 200

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

Module M0982: Trans	portation Modelling		
Courses			
Title	Тур	Hrs/wk	СР
Fransportation Modelling (L1180)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Carsten Gertz		
Admission Requirements	None		
<b>Recommended Previous</b>	some knowledge of transport planning, e.g. through taking the undergraduate class "Transport	Planning and	Traffic Engineering
Knowledge			
Educational Objectives	After taking part successfully, students have reached the following learning results		
Professional Competence			
Knowledge	Students are able to understand the operation and potential applications of transport models.		
Skille	Students are able to:		
JKIIIS			
	<ul> <li>use travel demand modelling software packages for solving practical problems.</li> </ul>		
	<ul> <li>design a database structure for travel demand models.</li> </ul>		
	assess modelling results.		
	<ul> <li>appraise potential applications and limitations of such models.</li> </ul>		
	<ul> <li>Students are able to independently develop and document solutions.</li> <li>Students are able to: <ul> <li>independently organise, manage and solve set tasks.</li> <li>independently prepare written reports.</li> </ul> </li> </ul>		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Credit points			
Course achievement			
Examination	Written elaboration		
Examination duration and	written assignment with presentation during the semester		
scale			
Assignment for the	Civil Engineering: Specialisation Water and Traffic: Compulsory		
Following Curricula		lsory	
<u> </u>	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory	2	

Course L1180: Transportation Modelling		
Тур	Project-/problem-based Learning	
Hrs/wk	4	
СР	6	
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56	
Lecturer	Prof. Carsten Gertz	
Language	DE	
Cycle	SoSe	
Content	<ul> <li>Principles of transport modelling</li> <li>Role of transport modelling in the planning process</li> <li>Fundamentals of mobility behaviour</li> <li>Design and evaluation of transport/mobility surveys</li> <li>mode of operation and data requirements for different stages of modelling</li> <li>Forecasting and scenarios in the transport planning</li> <li>The range of model applications (from transport infrastructure planning over simulation of traffic flows to integrated land-use and transport models as well as the use of models for evaluating locations)</li> <li>Practice-oriented project for assessing consequences of infrastructure projects and changes in land-use</li> </ul>	
Literature	Lohse, Dieter und Schnabel, Werner (2011): Grundlagen der Straßenverkehrstechnik und der Verkehrsplanung – Band 2. 3. Auflage. Beuth. Ortúzar, Juan de Dios und Willumsen, Luis G. (2011): Modelling Transport. 4. Auflage. John Wiley & Sons.	

Courses				
Title		Тур	Hrs/wk	СР
Solid Matter Process Technology fo	Biomass (10052)	Lecture	2	2
Thermal Waste Treatment (L0320)		Lecture	2	2
Thermal Waste Treatment (L1177)		Recitation Section (large)	1	2
Module Responsible	Prof. Kerstin Kuchta			
Admission Requirements	None			
Recommended Previous	Basics of			
Knowledge				
-	<ul> <li>thermo dynamics</li> </ul>			
	fluid dynamics			
	chemistry			
Educational Objectives	After taking part successfully, students have r	eached the following learning results		
Professional Competence				
Knowledge	The students can name, describe current is	ssue and problems in the field of therma	al waste treatment	and particle proce
5	engineering and contemplate them in the con	text of their field.		
	The industrial application of unit operations a			
	technologies and solid biomass processes. C			
	renewable resources and wastes are describe		cing solid fuels and	bioethanol, produci
	and refining edible oils, electricity , heat and mineral recyclables.			
Skills	s The students are able to select suitable processes for the treatment of wastes or raw material with respect to their character			o their characterist
	and the process aims. They can evaluate the	efforts and costs for processes and select e	conomically feasible	treatment concepts
Personal Competence				
Social Competence	Students can			
	<ul> <li>respectfully work together as a team ar</li> </ul>	nd discuss technical tasks		
	<ul> <li>participate in subject-specific and inter-</li> </ul>	disciplinary discussions,		
	<ul> <li>develop cooperated solutions</li> </ul>			
	<ul> <li>promote the scientific development an</li> </ul>	d accept professional constructive criticism		
A 1				-
Autonomy	Students can independently tap knowledge			
	consultation with supervisors, to assess their			
	targets for new application-or research-oriente	ed duties in accordance with the potential s	ocial, economic and	cultural impact.
Workload in Hours	Independent Study Time 110, Study Time in L	ecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Water and Tr	affic: Elective Compulsory		
Following Curricula	Bioprocess Engineering: Specialisation A - Ger	neral Bioprocess Engineering: Elective Comp	oulsory	
	International Management and Engineering: S	pecialisation II. Process Engineering and Bio	otechnology: Elective	e Compulsory
	International Management and Engineering: S	pecialisation II. Renewable Energy: Elective	Compulsory	
	Renewable Energies: Specialisation Bioenergy			
	Process Engineering: Specialisation Chemical			
	Process Engineering: Specialisation Process En	ngineering: Elective Compulsory		
	Process Engineering: Specialisation Environme		sory	
	Water and Environmental Engineering: Specia	lisation Environment: Compulsory		
	Water and Environmental Engineering: Specia			

Course L0052: Solid Matter F	Process Technology for Biomass
Тур	Lecture
Hrs/wk	2
CP	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Werner Sitzmann
Language	DE
Cycle	SoSe
	The industrial application of unit operations as part of process engineering is explained by actual examples of solid biomass processes. Size reduction, transportation and dosing, drying and agglomeration of renewable resources are described as important unit operations when producing solid fuels and bioethanol, producing and refining edible oils, when making Btl - and WPC - products. Aspects of explosion protection and plant design complete the lecture. Kaltschmitt M., Hartmann H. (Hrsg.): Energie aus Bioamsse, Springer Verlag, 2001, ISBN 3-540-64853-4
	Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz, Schriftenreihe Nachwachsende Rohstoffe, Fachagentur Nachwachsende Rohstoffe e.V. www.nachwachsende-rohstoffe.de Bockisch M.: Nahrungsfette und -öle, Ulmer Verlag, 1993, ISBN 380000158175

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

Course L1177: Thermal Wast	ourse L1177: Thermal Waste Treatment	
Тур	Recitation Section (large)	
Hrs/wk	1	
СР	2	
Workload in Hours	Independent Study Time 46, Study Time in Lecture 14	
Lecturer	Prof. Kerstin Kuchta	
Language	EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

Courses					
Title		Тур	Hrs/wk	СР	
Groundwater Modeling using Modflow (L0543)		Lecture	1 2	1 2	
Groundwater Modeling using Modfl Modeling of Water Supply and Sew		Recitation Section (small) Project-/problem-based Learning	2	2	
Module Responsible		· · · · · · · · · · · · · · · · · · ·	_	-	
Admission Requirements	None				
Recommended Previous	Groundwater				
Knowledge					
	groundwater hydraulics and transport of substances				
	Pipe Systems				
	<ul> <li>Knowledge on urban water infrastructures, i</li> </ul>	in particular drinking water systemsand u	ırhan drainad	e systems includi	
	special structures		aranag		
	<ul> <li>Hydraulics of drinking water supply systems and</li> </ul>	nd sewer systems			
	Basic knowledge on water management				
Educational Objectives	After taking part successfully, students have reached	the following learning results			
Professional Competence	51 5.	5 5			
Knowledge	The students are able to describe the modelling of groundwater flow and transport as well as urban water infrastructures. They				
	carry out systems analyses and can detect technical and conceptual weak points within the systems in case studies. Besides the				
	are able to analyse interdependencies of hydraulic ar	nd 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 exit		oftware produ	cts. The students a	
	able to use different software solutions (e.g. EPANET,	EPA-SWMM).			
Personal Competence					
Social Competence	Wird nicht vermittelt.				
Autonomy	Wird nicht vermittelt.				
Workload in Hours	Independent Study Time 110, Study Time in Lecture	70			
Credit points					
Course achievement	None				
Examination	Oral exam				
Examination duration and	20 min				
scale					
Assignment for the	Civil Engineering: Specialisation Structural Engineerin	5 1 5			
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine	5 1 5			
	Civil Engineering: Specialisation Coastal Engineering: Civil Engineering: Specialisation Water and Traffic: El	, ,			
	Water and Environmental Engineering: Specialisation				
	Water and Environmental Engineering: Specialisation				
	Water and Environmental Engineering: Specialisation				

	Course L0543: Groundwater Mo
	Typ Le
	Hrs/wk 1
	<b>CP</b> 1
	Workload in Hours In
	Lecturer So
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Course L0544: Groundwater	urse L0544: Groundwater Modeling using Modflow	
Тур	Recitation Section (small)	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Lecturer	Sonja Götz	
Language	DE/EN	
Cycle	SoSe	
Content	See interlocking course	
Literature	See interlocking course	

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

Module M0870: Mana	gement of Surface Water				
Courses					
Title		Тур	Hrs/w	/k	СР
Modelling of Flow in Rivers and Est		Lecture	3		4
	ring / Integrated Flood Protection (L0961)	Project-/problem-based	Learning 2		2
Module Responsible	Prof. Peter Fröhle				
Admission Requirements	None				
<b>Recommended Previous</b>	Fundamentals of Hydromechanics, Hydraulics,	Hydrology and Hydraulic Engineerin	ıg; Hydraulic En	gineering	g I and Hydra
Knowledge	Engineering II				
Educational Objectives	After taking part successfully, students have reach	hed the following learning results			
Professional Competence					
Knowledge	Students are able to define in detail the basic	processes that are related to the m	odelling of flows	s in hydr	aulic engineer
	Besides, they can describe the basic aspects of r	numerical modelling and actual nume	rical models for t	the simul	lation of flows
	waves. They can also depict the concepts of natur	re oriented hydraulic engineering.			
Skills	Students are able to apply hydrodynamic-numeric	al models to practical hydraulic engin	opering tasks Fur	thermore	the students
JKIIIS	able to set up flood-risk management concepts ar	1 , 5	5		
			rendeal action to p	, accieding	propretion
Personal Competence					
Social Competence	The students are able to deploy their gained kno	wledge in applied problems of the pr	actical nature-ba	ised hydr	raulic engineeri
	Additionaly, they will be able to work in team with	engineers of other disciplines.			
Autonomy	The students will be able to independently extend	I their knowledge and apply it to new	problems.		
Workload in Hours	Independent Study Time 110, Study Time in Lectu	ire 70			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	The duration of the examination is 150 min. The	e examination includes tasks with re	espect to the ger	neral und	derstanding of
scale	lecture contents and calculations tasks.				
Assignment for the	Civil Engineering: Specialisation Water and Traffic	: Compulsory			
Following Curricula	Environmental Engineering: Core Qualification: Ele	ective Compulsory			
	Joint European Master in Environmental Studies -	Cities and Sustainability: Core Qualific	ation: Compulso	ry	
	Water and Environmental Engineering: Specialisat	tion Water: Compulsory			
	Water and Environmental Engineering: Specialisat	tion Environment: Compulsory			
	Water and Environmental Engineering: Specialisat	tion Cities: Elective Compulsory			

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

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

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

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

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

Workload in Hours	
	ndependent Study Time 32, Study Time in Lecture 28
Lecturer F	rank Feindt
Language	)E
Cycle S	joSe
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>

Module M0857: Geocl	nemical Engineering			
Courses				
Title		Тур	Hrs/wk	СР
Contaminated Sites and Landfilling		Lecture	2	2
Contaminated Sites and Landfilling Geochemical Engineering (L0904)	(L0907)	Recitation Section (large) Lecture	1	2
	Dr. Marras Ditalianuali	Lecture	2	Z
Module Responsible				
Admission Requirements	None			
Recommended Previous	Module: General and Inorganic Chemistry,			
Knowledge	Module:Organic Chemistry,			
	Biology (Basic Knowledge)			
Educational Objectives	After taking part successfully, students ha	ve reached the following learning results		
Professional Competence				
Knowledge	With the completion of this module stude	ents acquire profound knowledge of biogeoche	mical processes, the	e fate of pollutants
	soil and groundwater, and techniques to d	eposit contaminated waste material. They are	able to describe in pr	rinciple the behavio
	of chemicals in the environment. Students	can explain and report the approach to remed	iate contaminated si	tes.
Skills		ents can apply the acquired theoretical knowle	-	
		nd conceptually. They are able to draw compa	risons on different re	emediation strategie
	and techniques. Model projects can be dev	vised and treated.		
Personal Competence				
Social Competence	Students can discuss technical and scient	ific tasks within a seminar subject specific and	interdisciplinary .	
Autonomy	Students can independently exploit source	es , acquire the particular knowledge of the sub	ject and apply it to n	ew problems.
Workload in Hours	Independent Study Time 110, Study Time	in Lecture 70		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	2 hours			
scale				
Assignment for the	Civil Engineering: Specialisation Water and	Traffic: Elective Compulsory		
Following Curricula	Environmental Engineering: Core Qualifica	tion: Elective Compulsory		
	Water and Environmental Engineering: Spe	ecialisation Water: Elective Compulsory		
	Water and Environmental Engineering: Sp	ecialisation Environment: Elective Compulsory		
	Water and Environmental Engineering: Spo	ecialisation Cities: Elective Compulsory		

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

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

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

grated Lecture grated Lecture itation Section (small) uning, and sensor technolo .0 and cyber-physical system writing and good English arning results es of smart monitoring. The tel monitoring of system plement intelligent senson ed computing methodolog ign smart monitoring system focus will be put on t	The students will ms in the built a or systems using s gies. Besides lectu ystems that integ	the will to deep be able to desi and in the natu state-of-the-art da
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te) monitoring of syster plement intelligent sensor ed computing methodolog ign smart monitoring sy	ms in the built a or systems using s gies. Besides lectu ystems that integ	and in the natu state-of-the-art da
world (built or natural) sy ery group will be docume g system in the annual " ule will be taught in Englis	ystems, such as b ented in a paper. "Smart Monitoring	of machine learn pridges or slopes, All students of t g" competition. T
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Course L2762: Smart Monito	ring
Тур	Integrated Lecture
Hrs/wk	2
СР	2
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	In this course, principles of smart monitoring will be taught, focusing on modern concepts of data acquisition, data storage, and data analysis. Also, fundamentals of intelligent sensors and embedded computing will be illuminated. Autonomous software and decentralized data processing are further crucial parts of the course, including concepts of the Internet of Things, Industry 4.0 and cyber-physical systems. Furthermore, measuring principles, data acquisition systems, data management and data analysis algorithms will be discussed. Besides the theoretical background, numerous practical examples will be shown to demonstrate how smart monitoring may advantageously be used for assessing the condition of systems in the built or natural environment.
Literature	

Course L2763: Smart Monito	ring
Тур	Recitation Section (small)
Hrs/wk	2
СР	4
Workload in Hours	Independent Study Time 92, Study Time in Lecture 28
Lecturer	Prof. Kay Smarsly
Language	EN
Cycle	WiSe/SoSe
Content	The contents of the exercises are based on the lecture contents. In addition to the exercises, project work will be conducted, which will consume the majority of the workload. As part of the project work, students will design smart monitoring systems that will be tested in the laboratory or in the field. As mentioned in the module description, the students will participate in the "Smart Monitoring" competition, hosted annually by the Institute of Digital and Autonomous Construction. Students are encouraged to contribute their own ideas. The tools required to implement the smart monitoring systems will be taught in the group exercises as well as through external sources, such as video tutorials and literature.
Literature	

Courses						
Title		Тур	Hrs/wk	СР		
Rural Development and Resources	Oriented Sanitation for different Climate Zones (L0942)	Seminar	2	3		
Rural Development and Resources	Oriented Sanitation for different Climate Zones (L0941)	Lecture	2	3		
Module Responsible	Prof. Ralf Otterpohl					
Admission Requirements	None					
<b>Recommended Previous</b>	Basic knowledge of the global situation with rising povert	y, soil degradation, lack of v	vater resources and sanit	ation		
Knowledge						
Educational Objectives	After taking part successfully, students have reached the	following learning results				
Professional Competence						
Knowledge	Students can describe resources oriented wastewater s	ystems mainly based on so	ource control in detail. Th	ney can comment		
	techniques designed for reuse of water, nutrients and soil conditioners.					
	Students are able to discuss a wide range of proven appr	anchos in Rural Dovelopmer	at from and for many road	and of the world		
	Students are able to discuss a wide range of proven appr	oaches in Kurai Developinei	It from and for many regi	ons of the world.		
Skills	Students are able to design low-tech/low-cost sanitation	on, rural water supply, rain	water harvesting system	ns, measures for t		
	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						
	The students are able to develop a specific topic in a tea	m and to work out milestone	e according to a given pl	an		
Social Competence	The students are able to develop a specific topic in a tea			dii.		
Autonomy	Students are in a position to work on a subject and to	organize their work flow i	ndependently. They can	also present on th		
	subject.					
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56					
Credit points	6					
Course achievement	None					
Examination	Subject theoretical and practical work					
Examination duration and	During the course of the semester, the students work to	wards mile stones. The wor	k includes presentations	and papers. Detail		
scale	information will be provided at the beginning of the smea	iter.				
Assignment for the	Civil Engineering: Specialisation Water and Traffic: Election	ve Compulsory				
Following Curricula	Bioprocess Engineering: Specialisation A - General Biopro	cess Engineering: Elective C	Compulsory			
	Chemical and Bioprocess Engineering: Specialisation Ger	eral Process Engineering: El	ective Compulsory			
	Environmental Engineering: Specialisation Water: Electiv	e Compulsory				
	International Management and Engineering: Specialisation	n II. Energy and Environmer	ntal Engineering: Elective	Compulsory		
	Joint European Master in Environmental Studies - Cities a	nd Sustainability: Specialisa	tion Water: Elective Com	oulsory		
	Process Engineering: Specialisation Environmental Proces	ss Engineering: Elective Com	npulsory			
	Process Engineering: Specialisation Process Engineering:	Elective Compulsory				
	Water and Environmental Engineering: Specialisation Wa	ter: Elective Compulsory				
	Water and Environmental Engineering: Specialisation Env	vironment: Elective Compuls	ory			

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

Course L0941: Rural Develop	ment and Resources Oriented Sanitation for different Climate Zones
Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	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>

Courses							
Title		Тур	Hrs/wk	СР			
Process Modelling of Wastewater T	reatment (L0522)	Project-/problem-based Learning	2	3			
Process Modeling in Drinking Water	Treatment (L0314)	Project-/problem-based Learning	2	3			
Module Responsible	Dr. Klaus Johannsen						
Admission Requirements	None						
<b>Recommended Previous</b>	Knowledge of the most important processes in drinking water and waste water treatment.						
Knowledge							
Educational Objectives	After taking part successfully, students have r	eached the following learning results					
<b>Professional Competence</b>							
Knowledge	Students are able to explain selected process	ses of drinking water and waste water treatment i	n detail. They	/ are able to expla			
	basics as well as possibilities and limitations o	f dynamic modeling.					
<i></i>	Challen and the second s						
Skills		features Modelica offers. They are able to transpo					
		ematical model in Modelica with respect to equilib	rium, kinetics	and mass balance			
	They are able to set up and apply models and	assess their possibilities and limitations.					
Demonstration of the second							
Personal Competence							
Social Competence		ment solutions in a group with members of different		ackground. They a			
	able to give appropriate feedback and can wo	rk constructively with feedback concerning their wo	ork.				
Autonomy	Students are able to define a problem, gain th	e required knowledge and set up a model.					
	Independent Study Time 124, Study Time in L	ecture 56					
Credit points	6						
Course achievement							
Examination							
Examination duration and scale	30 min						
	Civil Engineering, Specialization Water and Tr	office Elective Compulson					
Assignment for the Following Curricula	Civil Engineering: Specialisation Water and Tra Environmental Engineering: Specialisation Wa						
rollowing curricula		ter: Elective Compulsory es - Cities and Sustainability: Specialisation Water: F	-lective Comp	ulsory			
		ental Process Engineering: Elective Compulsory	Liective Comp	Juisory			
	Process Engineering: Specialisation Environme Process Engineering: Specialisation Process Er						
	Water and Environmental Engineering: Special						
	Water and Environmental Engineering: Specia						
	water and Environmental Engineering. Specia	isación Environment. Elective compuisory					

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

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

Courses							
Title			Тур	Hrs/wk	СР		
Waste and Environmental Chemist	ry (L0328)		Practical Course	2	2		
Biological Waste Treatment (L0318	3)		Project-/problem-based Le	earning 3	4		
Module Responsible	Prof. Kerstin Kuchta						
Admission Requirements	None						
<b>Recommended Previous</b>	chemical and biologic	cal basics					
Knowledge							
Educational Objectives	After taking part succ	cessfully, students have r	eached the following learning results				
Professional Competence							
Knowledge	design and layout of	anaerobic and aerobic wa	ng the planning of biological waste treatme iste treatment plants in detail, describe difi d explain different methods for waste anal	ferent techniques for			
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							
Social Competence	Students can particip	pate in subject-specific a	nd interdisciplinary discussions, develop co	operated solutions	and defend their o		
	work results in front of others and promote the scientific development in front of colleagues. Furthermore, they can give a accept professional constructive criticism.						
Autonomy	Students can independently tap knowledge from literature, business or test reports and transform it to the course projects. The are capable, in consultation with supervisors as well as in the interim presentation, to assess their learning level and define 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 T	ime 110, Study Time in L	ecture 70				
Credit points							
Course achievement		Form	Description				
	Yes None	Subject theoretical	and				
		practical work					
Examination	Presentation						
Examination duration and	Elaboration and Prese	entation (15-25 minutes i	n groups)				
scale		ocialisation Structural End					
Assignment for the	• • •	-	ineering: Elective Compulsory				
	Civil Engineering: Spe	ecialisation Geotechnical	Engineering: Elective Compulsory				
Assignment for the	Civil Engineering: Spe Civil Engineering: Spe	ecialisation Geotechnical ecialisation Coastal Engin	Engineering: Elective Compulsory eering: Elective Compulsory				
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Assignment for the	Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Environmental Engine	ecialisation Geotechnical ecialisation Coastal Engin ecialisation Water and Tra eering: Core Qualification	Engineering: Elective Compulsory eering: Elective Compulsory iffic: Elective Compulsory : Compulsory	Engineering: Elective	Compulsory		
Assignment for the	Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Environmental Engine International Manage	ecialisation Geotechnical ecialisation Coastal Engin ecialisation Water and Tra eering: Core Qualification ement and Engineering: S	Engineering: Elective Compulsory eering: Elective Compulsory iffic: Elective Compulsory : Compulsory pecialisation II. Energy and Environmental B				
Assignment for the	Civil Engineering: Spe Civil Engineering: Spe Civil Engineering: Spe Environmental Engine International Manage Joint European Maste	ecialisation Geotechnical ecialisation Coastal Engin ecialisation Water and Tra eering: Core Qualification ement and Engineering: S er in Environmental Studie	Engineering: Elective Compulsory eering: Elective Compulsory iffic: Elective Compulsory : Compulsory				

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

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

Courses								
Title					Тур	Hrs/wk	СР	
Advanced Topics in Waste Resourc	-	nt (L1055)			Project-/problem-based Learning	3 2	3 3	
International Waste Management (					Project-/problem-based Learning	Z	3	
Module Responsible								
Admission Requirements								
	basics in waste treatment technologies							
Knowledge	A (1				· · · · · · · · · · · · · · · · · · ·			
Educational Objectives	After taking	g part succ	cessfully, students have	reached the followi	ing learning results			
Professional Competence	The should be				and a share and the share lead of the state			
Knowledge					as advanced technologies for re		-	
	from waste in detail. This covers collection, transport, treatment and disposal in national and international contexts.							
Skills	Students a	re able to	select suitable processe	s for the treatment	with respect to the national or c	ultural and dev	velopmental cont	
	They can evaluate the ecological impact and the technical effort of different technologies and management systems.							
Demonstration of the second								
Personal Competence	Churche antes a			<b>F</b>	installa subject succific and int			
Social Competence			-		ipate in subject-specific and intent of others and promote the sci			
			n give and accept profe			entine develop	Sillenc of colleag	
	i uluiennoi	re, they ca	in give and accept profe		e chicisiiis.			
Autonomy	Students c	an indepe:	ndently gain additional	knowledge of the	subject area and apply it in so	olving the give	en course tasks	
	projects.							
Workload in Hours	Independe	nt Study T	ime 110, Study Time in	ecture 70				
Credit points								
		Bonus	Form	Description				
Course achievement	Yes	20 %	Written elaboration					
Course achievement		on						
Course achievement Examination	Presentatio							
		-	tion (10-15 minutes)					
Examination		-	tion (10-15 minutes)					
Examination Examination duration and scale	PowerPoint	t presental	tion (10-15 minutes) ecialisation Water and T	raffic: Elective Com	pulsory			
Examination Examination duration and scale Assignment for the	PowerPoint Civil Engine	t presentat eering: Spe						
Examination Examination duration and scale Assignment for the	PowerPoint Civil Engine Environme	t presentat eering: Spo ental Engin	ecialisation Water and T eering: Specialisation W	aste and Energy: El		: Elective Com	pulsory	
Examination Examination duration and scale Assignment for the	PowerPoint Civil Engine Environme Joint Europ	t presental eering: Spo ental Engino pean Maste	ecialisation Water and T eering: Specialisation W	aste and Energy: El es - Cities and Sust	lective Compulsory tainability: Specialisation Energy	: Elective Com	pulsory	
Examination Examination duration and scale Assignment for the	PowerPoint Civil Engine Environme Joint Europ Water and	eering: Spo ental Engino ean Maste Environme	ecialisation Water and T eering: Specialisation W r in Environmental Stud ental Engineering: Speci	aste and Energy: El es - Cities and Susi alisation Water: Ele	lective Compulsory tainability: Specialisation Energy	: Elective Com	pulsory	

Course L1055: Advanced Top	pics in Waste Resource Management
Тур	Project-/problem-based Learning
Hrs/wk	3
СР	3
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42
Lecturer	Prof. Rüdiger Siechau
Language	EN
Cycle	WiSe
Content	<ul> <li>Focus of the course "Advanced topics of waste resource management" lies on the organisational structures in waste management - such as planning, financing and logistics. One excursion will be offered to take part in (incineration plant, vehicle fleet and waste collection systems).</li> <li>The course is split into two parts: <ol> <li>part: "Conventional" lecture (development of waste management, legislation, collection, transportation and organisation of waste management, costs, fees and revenues).</li> <li>part: Project base learning: You will get a project to work out in groups of 4 to 6 students; all tools and data you need to work out the project were given before during the conventional lecture. Course documents are published in StudIP and communication during project work takes place via StudIP.</li> </ol> </li> <li>The results of the project work are presented at the end of the semester. The final mark for the course consists of the grade for the presentation.</li> </ul>
Literature	Einführung in die Abfallwirtschaft; Martin Kranert, Klaus Cord-Landwehr (Hrsg.); Vieweg + Teubner Verlag; 2010 PowerPoint slides in Stud IP

Course L0317: International	Waste Management
Тур	Project-/problem-based Learning
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Kerstin Kuchta
Language	EN
Cycle	WiSe
Content	Waste avoidance and recycling are the focus of this lecture. Additionally, waste logistics ( Collection, transport, export, fees and taxes) as well as international waste shipment solutions are presented. Other specific wastes, e.g. industrial waste, treatment concepts will be presented and developed by students themselves Waste composition and production on international level, wast eulogistic, collection and treatment in emerging and developing countries. Single national projects and studies will be prepared and presented by students
Literature	Basel convention

Courses					
Title			Тур	Hrs/wk	СР
Concrete Structures (L0579)			Seminar	1	1
Structural Concrete Members (L05			Lecture	2	3
Structural Concrete Members (L05	-,		Recitation Section (large)	2	2
Module Responsible		ich			
Admission Requirements	None				
Recommended Previous	Basics of structural	analysis, conception and	d dimensioning of structural concrete		
Knowledge	Modules: Reinforce	d Concrete Structures I+	II, Structural Analysis I+II, Mechanics I+II		
			,		
	After taking part su	ccessfully, students hav	e reached the following learning results		
Professional Competence					
Knowledge	The students broaden their skills in structural engineering, especially in the field of buildings (houses, roofs, halls). They dispose				
	the knowledge for t	he conception and desig	n of concrete buildings and structural members	that are often use	d.
	-				
SKIIIS	Is The students are able to apply procedures of the conception and dimensioning to to practical problems of structural engineer They are capable to draft concrete buildings and to design them for general action effects and to plan their detailing				
				n their detailing	
	execution. Moreove	r, they can make design	and construction sketches and draw up technic	cal descriptions.	
Personal Competence					
	The students are al	ole to obtain results of hi	gh quality in teamwork		
	The students are able to obtain results of high quality in teamwork.				
Autonomy	The students are able to carry out complex conception and dimensioning tasks of structures under the guidance of tutors.				
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70				
	, ,	Time 110, Study Time I			
Credit points					
Credit points		Form	Description		
Credit points Course achievement		Form Presentation			
	Compulsory Bonus		Description Es werden 2 Referate ausgegeben		
Course achievement Examination	CompulsoryBonusYesNoneWritten exam				
Course achievement Examination Examination duration and	CompulsoryBonusYesNoneWritten exam				
Course achievement Examination Examination duration and scale	Compulsory         Bonus           Yes         None           Written exam         120 minutes	Presentation	Es werden 2 Referate ausgegeben		
Course achievement Examination Examination duration and scale Assignment for the	Compulsory         Bonus           Yes         None           Written exam         120 minutes           Civil Engineering: S         S	Presentation pecialisation Structural I	Es werden 2 Referate ausgegeben		
Course achievement Examination Examination duration and scale	Compulsory         Bonus           Yes         None           Written exam         120 minutes           Civil Engineering: S         Civil Engineering: S	Presentation pecialisation Structural I pecialisation Geotechnic	Es werden 2 Referate ausgegeben		
Course achievement Examination Examination duration and scale Assignment for the	Compulsory         Bonus           Yes         None           Written exam         120 minutes           Civil Engineering: S         S           Civil Engineering: S         S           Civil Engineering: S         S	Presentation pecialisation Structural I pecialisation Geotechnic pecialisation Coastal Eng	Es werden 2 Referate ausgegeben		

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

Typ       Lecture         Hrs/wk       2         CP       3         Workload in Hours       Independent Study Time 62, Study Time in Lecture 28         Lecturer       Prof. Günter Rombach         Language       DE         Cycie       Wise         Content       • skyscrapers: structural elements         • actions on structrues       • bracing systems         • design of slabs (line and point supported plates and floor slabs)       • membranes and deep beams         • folded plates and shells       • trues models         • trues models       • reinforced and prestressed members         Vorlesungsunterlagen können im STUDiP heruntergeladen werden       • Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010         • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Tell II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003         • Phocas, Marios C.: Hochhäuser i: Tragwerk und Konstruktion, Stuttgart, Teubner, 2005         • Deutscher Ausschuss für Stahlbeton: Het 700: Hifdwirtled zur Berechnung der Schnittgrößen und Formånderungen vo Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978         • Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1973         • Schlaich J.: Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721f, Verlag E
CP 3         Workload in Hours         Independent Study Time 62, Study Time in Lecture 28         Lecturer         Prof. Günter Rombach         Laguage         DE         Cycle         Wise         Content         • skyscrapers: structural elements         • actions on structures       • bracing systems         • design off slabs (line and point supported plates and floor slabs)       • membranes and deep beams         • folded plates and shells       • truss models         • truss models       • reinforced and prestressed members         Literature       Vorlesungsunterlagen können im STUDIP heruntergeladen werden         • Zlich K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010         • König, G., Liphardt S.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005         • Deutscher Ausschuss für Stahlbeton: Heft 200: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012         • Deutscher Ausschuss für Stahlbeton: Heft 240: Hiffsmittel zur Berechnung der Schnittgrößen und Formänderungen vo Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978         • Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1973
Workload in Hours         Independent Study Time 62, Study Time in Lecture 28           Lecturer         Prof. Günter Rombach           Language         DE           Cycle         Wise           Content         • skyscrapers: structural elements           • actions on structrues         • bracing systems           • design orf slabs (line and point supported plates and floor slabs)         • membranes and deep beams           • folded plates and shells         • trues models           • reinforced and prestressed members         Vorlesungsunterlagen können im STUDIP heruntergeladen werden           • Zlich K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010         • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003           • Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005         • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012           • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012         • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012           • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012         • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012           • Deutscher Ausschuss für Stahlbeton: Heft
Lecturer       Prof. Günter Rombach         Language       DE         Cycle       WiSe         Content       • skyscrapers: structural elements         • actions on structrues       • bracing systems         • design orf slabs (line and point supported plates and floor slabs)       • membranes and deep beams         • folded plates and shells       • truss models         • reinforced and prestressed members         Literature       Vorlesungsunterlagen können im STUDIP heruntergeladen werden         • Zlich K., Zehetmaier G.: Bernessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010       • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003         • Phocas, Marios C.: Hochhäuser : Traywerk und Konstruktiven Stutktion, Stuttgart, Teubner, 2005       • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterrungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012         • Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen vo Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978         • Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992         • Stiglat, K., Wippel: Platten. Verlag Ernst & Sohn, Berlin 1992         • Stiglat/Wippel: Platten Verlag Ernst & Sohn, Berlin 1992         • Stiglat/Wippel: Platten Verlag Ernst & Sohn, Berlin 1992
Language         DE           Cycle         WiSe           Content         • skyscrapers: structural elements • actions on structrues • bracing systems • design orf slabs (line and point supported plates and floor slabs) • membranes and deep beams • folded plates and shells • truss models • reinforced and prestressed members           Literature         Vorlesungsunterlagen können im STUDIP heruntergeladen werden • Zlich K., Zehetmaier G.: Bernessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010 • König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003 • Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktiven, Stuttgart, Teubner, 2005 • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012 • Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen vo Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978 • Stüglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992 • Stüglat, K., Wippel: Platten. Verlag Ernst & Sohn, Berlin 1992 • Stiglat/Wippel: Platten. Verlag Ernst & Sohn, Berlin 1992
Cycle         WiSe           Content         • skyscrapers: structural elements           • actions on structrues         • bracing systems           • design orf slabs (line and point supported plates and floor slabs)         • membranes and deep beams           • folded plates and shells         • truss models           • reinforced and prestressed members           Literature         Vorlesungsunterlagen können im STUDIP heruntergeladen werden           • Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010           • König, G., Liphardt S.: Hochhäuser aus Stahlbeton. Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003           • Phocas, Marios C.: Hochhäuser aus Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1.1, Beuth Verlag, Berlin 2012           • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1.1, Beuth Verlag, Berlin 2012           • Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen vo Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978           • Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992           • Stiglat, K., Wippel, Hat: Nerlag Ernst & Sohn, Berlin 1973           • Schlaich J.; Schäfer K.: Konstruieren im Stahlbetonau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst & Sohn, Berlin 1998
Content       • skyscrapers: structural elements         • actions on structrues       • bracing systems         • design orf slabs (line and point supported plates and floor slabs)       • membranes and deep beams         • folded plates and shells       • truss models         • reinforced and prestressed members         Literature       Vorlesungsunterlagen können im STUDIP heruntergeladen werden         • Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010         • König, G., Liphardt S.: Hochñauser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst & Sohn, Berlin 2003         • Phocas, Marios C.: Hochñauser aus Stahlbeton, Etonstruktion, Stuttgart, Teubner, 2005         • Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-1-1, Beuth Verlag, Berlin 2012         • Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formänderungen vo Stahlbetontragwerken, Verlag Ernst & Sohn, Berlin 1978         • Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalende 1992, Teil I, 287-366, Verlag Ernst & Sohn, Berlin 1992         • Stiglat, K., Wippel: Platten. Verlag Ernst & Sohn, Berlin 1973         • Stiglat, K.; Worten, Verlag Ernst & Sohn, Berlin 1973         • Schlaich J.; Schäfer K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst & Sohn, Berlin 1998
<ul> <li>skyscrapers: structural elements</li> <li>actions on structrues</li> <li>bracing systems</li> <li>design orf slabs (line and point supported plates and floor slabs)</li> <li>membranes and deep beams</li> <li>folded plates and shells</li> <li>truss models</li> <li>reinforced and prestressed members</li> </ul> Literature Vorlesungsunterlagen können im STUDiP heruntergeladen werden <ul> <li>Zilch K., Zehetmaier G.: Bemessung im konstruktiven Ingenieurbau. Springer, Heidelberg 2010</li> <li>König, G., Liphardt S.: Hochhäuser aus Stahlbeton, Betonkalender 2003, Teil II, Seite 1-69, Verlag Ernst &amp; Sohn, Berlin 2003</li> <li>Phocas, Marios C.: Hochhäuser : Tragwerk und Konstruktion, Stuttgart, Teubner, 2005 <ul> <li>Deutscher Ausschuss für Stahlbeton: Heft 600: Erläuterungen zu DIN EN 1992-11, Beuth Verlag, Berlin 2012</li> <li>Deutscher Ausschuss für Stahlbeton: Heft 240: Hilfsmittel zur Berechnung der Schnittgrößen und Formånderungen vor Stahlbetontragwerken, Verlag Ernst &amp; Sohn, Berlin 1978</li> <li>Stiglat, K., Wippel, H.: Massive Platten - Ausgewählte Kapitel der Schnittkraftermittlung und Bemessung, Betonkalender 1992, Teil I, 287-366, Verlag Ernst &amp; Sohn, Berlin 1992</li> <li>Stiglat, K./Wippei: Platten. Verlag Ernst &amp; Sohn, Berlin 1992</li> <li>Stiglat, K.: Konstruieren im Stahlbetonbau. Betonkalender 1998, Teil II, S. 721ff, Verlag Ernst &amp; Sohn, Berlin 1998</li> </ul></li></ul>

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

Courses							
Title				Тур		Hrs/wk	СР
Computational Analysis of Concrete				Lecture		2	3
Computational Analysis of Concrete FE-Modeling of Concrete Structures		(L0599)		Recitation Sectior Project-/problem-I	. 5.7	1 2	1 2
-		D. I.	. b.	Project-/problem-	based Learning	Z	Z
Module Responsible		er Romba	cn				
•	None Basis know	uladaa in	structural analysis and	design of reinforced concrete structure	c (booms, slabs	choor walls)	
	Basic know	viedge in	structural analysis and	design of reinforced concrete structure	es (beams, slabs,	snear walls)	
Knowledge	Lectures '	Concrete	Structures I und II'				
	Lectures '	Structura	Analysis I and II'				
	Lecture 'C	oncrete S	tructures'				
Educational Objectives	After taking part successfully, students have reached the following learning 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							
Social Competence	The students can model and design in teamwork a real concrete structure by means of a finite element software package.						
A 1	The students can medal and design a real concrete structure based on a fight alcount affiness and the students						
Autonomy	The students can model and design a real concrete structure based on a finite element software package and discuss the problem						
	and results with other students.						
Workload in Hours	Independent Study Time 110, Study Time in Lecture 70						
Credit points	6						
Course achievement	Compulsory	Bonus	Form	Description			
	Yes	None	Attestation	Am Ende des Semster ist e	ein Tragsystem	mit dem R	echenprogramm z
				modellieren			
	Yes	None	Excercises	Es ist ein Tragsystem mit TEDI	DY zu modellierer	ı	
Examination	Oral exam						
Examination duration and	45 min						
scale							
Assignment for the							
	-			cal Engineering: Elective Compulsory			
· ····································	-			• • • • •			
	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory Civil Engineering: Specialisation Water and Traffic: Elective Compulsory						

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

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

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

Madula M0062, Steel	and Composite Structures			
Module M0905: Steel	and Composite Structures			
Courses				
Title		Тур	Hrs/wk	СР
Steel and Composite Structures (L1	204)	Lecture	2	2
Steel and Composite Structures (L1	205)	Recitation Section (large)	2	2
Steel Bridges (L1097)		Lecture	2	2
Module Responsible	Prof. Marcus Rutner			
Admission Requirements	None			
Recommended Previous Knowledge	Basics of steel construction (i.e. Steel Structures I and II, BUBC)			
Educational Objectives	After taking part successfully, students have reached the follow	ing loorning rocults		
	Arter taking part successiony, students have reached the follow	ing rearring results		
Professional Competence	After successful completition, students can			
Kilowieuge	Arter successful completition, students can			
	<ul> <li>describe the phenomenon of local buckling</li> </ul>			
	<ul> <li>explain warping torsion</li> </ul>			
	<ul> <li>illustrate the behaviour of composite structures</li> </ul>			
	<ul> <li>specify the principles in design of composite sttructures</li> </ul>			
	<ul> <li>sketch the contructions of steel and composite bridges</li> </ul>			
Skills	After successful participation students are able to			
	<ul> <li>check stiffened and unstiffened plated structures</li> </ul>			
	<ul> <li>recognize and verify warping tosion in strucures</li> </ul>			
	<ul> <li>design composite structures</li> </ul>			
	design bridges and o perform the detailing			
Personal Competence				
Social Competence				
Autonomy				
Workload in Hours	Independent Study Time 96, Study Time in Lecture 84			
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	180 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineering: Computed Structural Engineering: Computed Structure Struct	sory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elec	tive Compulsory		
	Civil Engineering: Specialisation Coastal Engineering: Elective C	ompulsory		
	Civil Engineering: Specialisation Water and Traffic: Elective Com	npulsory		
	International Management and Engineering: Specialisation II. Ci	vil Engineering: Elective Comp	oulsory	

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Subsoil and Underground Engineer	ing Law (L0395)	Lecture	2	3
Service Contract and Procurement	Law (L1906)	Lecture	2	3
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
<b>Recommended Previous</b>	Complete modules: Geotechnics I-III			
Knowledge				
Educational Objectives	After taking part successfully, students have rea	ached the following learning results		
Professional Competence				
Knowledge	Students will gain knowledge of			
	<ul> <li>the history of civil engineering law,</li> </ul>			
	<ul> <li>basics of foundation and civil engineering</li> </ul>	n law		
	<ul> <li>legal aspects of technical regulations in c</li> </ul>			
	<ul> <li>the civil engineering contract,</li> </ul>	in engineering (with case studies),		
	<ul> <li>the liability of the designer and contractor</li> </ul>	or in civil engineering		
	<ul> <li>the subsoil risk and the system risk,</li> </ul>	, in civil engineering,		
	<ul> <li>the total debt in (civil) engineering law,</li> </ul>			
	<ul> <li>the (construction) conflict, dispute avoida</li> </ul>	ance models and the construction proce	55	
	<ul> <li>the systematics of construction contract</li> </ul>		33,	
	<ul> <li>the BGB construction contract law,</li> </ul>	iavv,		
	<ul> <li>responsibilities on the construction site,</li> </ul>			
	<ul> <li>responsibilities on the construction site,</li> <li>remuneration and contract management</li> </ul>			
	<ul> <li>liability for defects,</li> </ul>	,		
	<ul><li>public procurement law.</li></ul>			
	• public procurement law.			
Skills	Students learn to apply legal aspects in plannin	g and construction in a legally balanced	way.	
Personal Competence				
	Students can work in groups and support each	other in finding solutions.		
Autonomy	Students are able to assess their own strengths	and weaknesses and organize their tim	e and learning manage	ment based on th
Workload in Hours	Independent Study Time 124, Study Time in Lea	cture 56		
Credit points				
Course achievement				
Examination	Oral exam			
Examination duration and	30 min			
scale				
Assignment for the	Civil Engineering: Specialisation Coastal Engine	5 1 5		
Following Curricula	Civil Engineering: Specialisation Geotechnical E	• • • • •		
	Civil Engineering: Specialisation Structural Engi	• • •		
	Civil Engineering: Specialisation Water and Traf	fic: Elective Compulsory		

Тур	Lecture
Hrs/wk	2
СР	3
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28
Lecturer	Prof. Günther Schalk
Language	DE
Cycle	WiSe
Content	History of Civil Engineering Law (from 1700 BC to 2000 AD)
	• Basics of foundation and excarvation law / engineering law (the participants in the case law of geotechnical law case studies)
	Legal aspects of technical regulations in civil engineering (with case studies)
	• The civil engineering contract (including checklists for the special civil engineering contract design and execution)
	• The liability of the planner and entrepreneur in civil engineering (practical examples, jurisprudence and law, inter alia, to
	Ordinance on Combatants, liability for defects and traffic safety obligations, construction law and insurance questions)
	• The ground / foundation risk and the systemic risk (also in the European context)
	The total debt in (low) building law (based on practice-oriented case constellations)
	• The (construction) conflict, the dispute avoidance models and the construction process (practice-oriented presentation)
Literature	Folienskript (in der Vorlesung erhältlich)
	weitere Literatur:
	Englert, Grauvogel und Maurer: Handbuch des Baugrund- und Tiefbaurechts. Werner-Verlag

Course L1906: Service Contr	ourse L1906: Service Contract and Procurement Law	
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Lecturer	Prof. Günther Schalk, Prof. Jürgen Grabe	
Language	DE	
Cycle	WiSe	
Content		
Literature		

Courses				
Title		Тур	Hrs/wk	СР
Water Protection and Wastewater Management (L0226) Water Protection and Wastewater Management (L2008)		Lecture Device the Construction	3	3
	5	Project Seminar	3	3
Module Responsible				
Admission Requirements	None			
Recommended Previous Knowledge	Basic knowledge in water managemer	it;		
Kilowieuge	<ul> <li>Good knowledge in urban drainage;</li> </ul>			
	<ul> <li>Good knowledge of wastewater treatment</li> </ul>	nent techniques;		
	<ul> <li>Good knowledge of pollutants (e.g. CC</li> </ul>	D, BOD, TS, N, P) and their properties;		
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence		5 5		
-	The students can describe the basic principle	es of the regulatory framework related to th	e international and Eu	Iropean water sect
	They can explain limnological processes, s	ubstance cycles and water morphology ir	detail. They are able	e to assess compl
	problems related to water protection, such	as ecosystem service and wastewater tre	atment with a special	focus on innovati
	solutions, remediation measures as well as c	onceptual approaches.		
Skills	Students can accurately assess current prob	plems and situations in a country-specific o	r local context. They o	an suggest concre
01110	actions to contribute to the planning of to			
	administrative and legislative solutions to so		, , ,	
Personal Competence				
Social Competence	The students can work together in internatio	nal groups.		
Autonomy	Students are able to organize their work flo	w to prepare presentations and discussions	s. They can acquire ap	propriate knowled
	by making enquiries independently.			
	Independent Study Time 96, Study Time in L	ecture 84		
Credit points				
Course achievement				
Examination	Term paper plus presentation			
scale	rem paper plus presentation			
•	Civil Engineering: Specialisation Structural En	• • • • •		
Following Curricula	Civil Engineering: Specialisation Geotechnica	• • • • •		
	Civil Engineering: Specialisation Coastal Eng	5 1 5		
	Civil Engineering: Specialisation Water and T			
	Environmental Engineering: Specialisation W		Compulsor	
	International Management and Engineering: Joint European Master in Environmental Stud			oulsory
	Water and Environmental Engineering: Speci		water. Lietuve com	561501 y
	Water and Environmental Engineering: Speci Water and Environmental Engineering: Speci			
	a set and a set a			

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

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

Module M0699: Geote				
Courses				
<b>Title</b> Numerical Methods in Geotechnics	(10375)	<b>Typ</b> Lecture	Hrs/wk 3	<b>СР</b> 3
Advanced Foundation Engineering		Lecture	2	2
Advanced Foundation Engineering	(L0498)	Recitation Section (large)	1	1
Module Responsible	Prof. Jürgen Grabe			
Admission Requirements	None			
Recommended Previous	Geotechnics I and II, Mathematics I-III			
Knowledge Educational Objectives	After taking part successfully, students have reache	d the following learning results		
Professional Competence	Arter taking part successiony, students have reache	d the following learning results		
	<ul> <li>After successfully completing the module, students will be able to <ul> <li>describe individual procedures for the geotechnical monitoring of civil engineering measures,</li> <li>reproduce exploration and investigation methods of the subsoil,</li> <li>select suitable types of field and laboratory tests for subsoil investigation and evaluate their results,</li> <li>state the differences between various stress and deformation states and the physical significance of invariants of the stread distortion tensor,</li> <li>outline the standard and special soil mechanics tests used to determine the stress-strain behavior of soil,</li> <li>describe continuum models and the resulting boundary value problems,</li> <li>as well as define boundary value problems from the field of geotechnical engineering in such a way that they can be solv unambiguously.</li> </ul> </li> <li>Students will be able to <ul> <li>dimension vertical drains for soil improvement of soft soils,</li> <li>calculate depth compaction using various appropriate methods,</li> <li>apply principles of horizontal bearing capacity of piles,</li> <li>verify the internal and external stability of fluid-supported diaphragm walls,</li> <li>evaluate the boundary conditions for the design of a deep excavation and design the individual components of the excavation,</li> <li>perform, evaluate and interpret tests for the description and classification of soils according to applicable standards,</li> <li>computationally implement numerical algorithms to solve boundary value problems,</li> </ul> </li> </ul>			
	<ul> <li>determine appropriate model parameters for of soils.</li> </ul>			
Personal Competence Social Competence	Students can work in groups and support each other	r in finding solutions.		
	Students can work in groups and support each other in finding solutions. Students are able to assess their own strengths and weaknesses and, based on this, organize their time and learning managem and think in terms of processes.		earning manageme	
Workload in Hours	Independent Study Time 96, Study Time in Lecture	84		
Credit points	6			
Course achievement	None			
Examination	Written exam			
Examination duration and	120 min			
scale				
Assignment for the	Civil Engineering: Specialisation Structural Engineer	ing: Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical Engine	eering: Compulsory		
	Civil Engineering: Specialisation Coastal Engineering	g: Compulsory		
	Civil Engineering: Specialisation Water and Traffic: E	elective Compulsory		
	International Management and Engineering: Special	isation II. Civil Engineering: Elective Comp	oulsory	

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

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

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

Courses				
Fitle	(1 2 7 2 1 )	Typ	Hrs/wk	<b>CP</b> 3
Modeling of Subsurface Processes Subsurface Solute Transport (L272		Recitation Section (small) Lecture	3	2
Subsurface Solute Transport (L272 Subsurface Solute Transport (L272		Recitation Section (large)	1	1
Module Responsible	Prof. Nima Shokri	-		
Admission Requirements				
Recommended Previous	Basic Mathematics, Hydrology			
Knowledge				
Educational Objectives	After taking part successfully, students have	reached the following learning results		
Professional Competence				
Knowledge	Upon completion of this module, the students will understand the mechanisms controlling solute transport in soil and na porous media and will be able to work with the equations that govern the fate and transport of solutes in porous media. Analy numerical and experimental tools and techniques will be used in this module.			
Skills	In addition to the physical insights, the students will be exposed to analytical, experimental and numerical tools and technique this module. This provides them with an excellent opportunity to improve their skills on multiple fronts which will be useful in future career.			
Personal Competence				
Social Competence	Teamwork & problem solving			
Autonomy	The students will be involved in writing ind	dividual reports and presentation. This will co	ntribute to the s	students' ability
	willingness to work independently and respon	nsibly.		
Workload in Hours	Independent Study Time 96, Study Time in Le	ecture 84		
Credit points	6			
Course achievement	None			
Examination	Subject theoretical and practical work			
Examination duration and	Report and Presentation			
scale				
Assignment for the	Civil Engineering: Specialisation Structural En	gineering: Elective Compulsory		
Following Curricula	Civil Engineering: Specialisation Geotechnical	Engineering: Elective Compulsory		
	Civil Engineering: Specialisation Coastal Engir	neering: Elective Compulsory		
	Civil Engineering: Specialisation Water and Tr	raffic: Elective Compulsory		
	Dracocc Engineering, Creciplication Environm	ental Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Environm	ental Process Engineering: Elective Compulsory		
	Process Engineering: Specialisation Process E	5 5 1 7		
	5 5 1	ingineering: Elective Compulsory		
	Process Engineering: Specialisation Process E	ingineering: Elective Compulsory alisation Water: Compulsory		

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

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

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

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

Courses					
Title		Тур	Hrs/wk	СР	
Environmental Research Trends (L	2752)	Seminar	2	2	
Microplastics in Environment (L2750)		Lecture	2	2	
Scientific Communication and Meth	ods (L2751)	Lecture	1	2	
Module Responsible	Prof. Nima Shokri				
Admission Requirements					
<b>Recommended Previous</b>	Basic knowledge on water, soil and env	vironmental research.			
Knowledge					
Educational Objectives	After taking part successfully, students	have reached the following learning results			
Professional Competence					
Knowledge	The students will be exposed to up-to-	date research topics focused on soil, water and	d climate related challer	nges with a particu	
	focus on the effects of microplastics in environment. Data analysis, data measurement, curation and presentation will be other				
	skills that the students will develop in t	his module.			
Skills	s Students' research skills will be improved in this module. How to prepare and deliver an effective presentation, how to write a				
	abstract, research paper and proposal will be discussed in this module. Moreover, through Research-Based Learning approache				
	the students will be exposed to current research trends in environmental engineering.				
Personal Competence					
Social Competence	Developing teamwork and problem solv	ving skills through Research-Based Teaching ap	proaches will be at the o	core of this modul	
Autonomy	The students will be involved in writ	ing individual reports and presentation. This	will contribute to the	students' ability a	
	willingness to work independently and			, , , , , , , , , , , , , , , , , , ,	
	Independent Study Time 110, Study Tin	me in Lecture 70			
Credit points					
Course achievement					
	Written elaboration				
Examination duration and	Report and Presentation				
scale					
-	Civil Engineering: Specialisation Water				
Following Curricula	Environmental Engineering: Specialisation Water: Elective Compulsory				
	• • •	ion Waste and Energy: Elective Compulsory			
	• • •	ion Biotechnology: Elective Compulsory			
		Specialisation Cities: Elective Compulsory			
	Water and Environmental Engineering:	Specialisation Environment: Elective Compulso	ry		
		Specialisation Water: Elective Compulsory			

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

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

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

Courses					
Title		Тур	Hrs/wk	СР	
Membrane Technology (L0399)		Lecture	2	3	
Membrane Technology (L0400)		Recitation Section (small)	1	2	
Membrane Technology (L0401)		Practical Course	1	1	
Module Responsible					
Admission Requirements Recommended Previous	None Rasis knowledge of water shomistry. Knowle	adae of the core processes involved in water, and	and stoom troot	nont	
Knowledge	basic knowledge of water chemistry. Knowle	edge of the core processes involved in water, gas	and steam treat	nenc	
Educational Objectives	After taking part successfully, students have	reached the following learning results			
Professional Competence	After taking part successionly, statents nave				
		pplications of industrially important membrane p membrane separation processes. Students will			
	membrane filtration and their advantages a membranes in water, other liquid media, ga	and disadvantages. Students will be able to expl ses and in liquid/gas mixtures.	ain the key diffe	erences in the use	
Skills	Skills Students will be able to prepare mathematical equations for material transport in porous and solution-diffusion membra calculate key parameters in the membrane separation process. They will be able to handle technical membrane process available boundary data and provide recommendations for the sequence of different treatment processes. Through the				
	experiments, students will be able to classify the separation efficiency, filtration characteristics and application of diffe membrane materials. Students will be able to characterise the formation of the fouling layer in different waters and apply techr measures to control this.				
Personal Competence					
Social Competence		ms on tasks in the field of membrane technology s to be undertaken jointly and present these to ot	-	le to make decision	
Autonomy	Students will be in a position to solve hom finding creative solutions to technical questi	nework on the topic of membrane technology incomes.	dependently. The	ey will be capable	
Workload in Hours	Independent Study Time 124, Study Time in	Lecture 56			
Credit points	6				
Course achievement	None				
Examination	Written exam				
Examination duration and	90 min				
scale					
Assignment for the	Civil Engineering: Specialisation Water and	Traffic: Elective Compulsory			
Following Curricula	Bioprocess Engineering: Specialisation A - G	eneral Bioprocess Engineering: Elective Compulso	ory		
	Bioprocess Engineering: Specialisation B - Industrial Bioprocess Engineering: Elective Compulsory				
	Chemical and Bioprocess Engineering: Specialisation Chemical Process Engineering: Elective Compulsory				
	Chemical and Bioprocess Engineering: Specialisation General Process Engineering: Elective Compulsory				
	Environmental Engineering: Specialisation W	/ater: Elective Compulsory			
	Joint European Master in Environmental Stud	lies - Cities and Sustainability: Specialisation Wate	er: Elective Com	oulsory	
	Process Engineering: Specialisation Process	Engineering: Elective Compulsory			
	Process Engineering: Specialisation Environr	mental Process Engineering: Elective Compulsory			
	Water and Environmental Engineering: Spec	ialisation Water: Elective Compulsory			
		ialisation Environment: Elective Compulsory			
	Water and Environmental Engineering: Spec				

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

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

Course L0401: Membrane Te	chnology
Тур	Practical Course
Hrs/wk	1
СР	1
Workload in Hours	Independent Study Time 16, Study Time in Lecture 14
Lecturer	Prof. Mathias Ernst
Language	EN
Cycle	WiSe
Content	See interlocking course
Literature	See interlocking course

Courses				
Title		Тур	Hrs/wk	СР
Scientific Working in Computationa	l Engineering (L2764)	Project-/problem-based Learning		6
Module Responsible	Prof. Kay Smarsly			
Admission Requirements	None			
<b>Recommended Previous</b>	Basic knowledge in scientific writing. St	ring interest in topics related to computing in civil engin	ieering.	
Knowledge				
Educational Objectives	After taking part successfully, students	have reached the following learning results		
<b>Professional Competence</b>				
Skills Personal Competence Social Competence	The students will learn to apply concepts and methods of scientific working in computational engineering. In interaction with t course instructors and in collaboration with each other, the students will also learn to understand the complex process of scient thinking, being able to accurately plan, implement and analyze scientific projects, such as prospective master theses. A proje will be conducted throughout the semester, which will contribute to the grade. Since scientific writing is of particular importance this course, a scientific paper will be developed based, which is a prerequisite for the final examination. The paper will be writt based on the project conducted within this course. Project meetings in small groups, presentations, and critical discussions scientific publications are further key activities.			
Autonomy				
	Independent Study Time 124, Study Tir	ne in Lecture 56		
Credit points				
Course achievement	None Written elaboration			
		recentation		
Examination duration and scale	10 pages of work with 15-minute oral p	resentation		
	Civil Engineering: Specialisation Water	and Traffic: Elective Compulsory		
-		chnical Engineering: Elective Compulsory		
. energeanteau	Civil Engineering: Specialisation Coasta			

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

Courses	
<b>Title</b> Adaptation to climate change in hy	draulic engineering (L2291) Typ Hrs/wk CP 6
Module Responsible	Prof. Peter Fröhle
Admission Requirements	
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 Skills	<ul> <li>Climate protection and climate adaptation</li> <li>Insights into climate change and its regional characteristics - fundamentals, climate modelling / climate models</li> <li>Impacts of climate change on the components of the regional hydrological cycle</li> <li>Fundamentals of analysis of climate data</li> <li>Consequences of the impact of the climate change</li> <li>Measures for climate adaptation</li> <li>Assessment, prioritization and communication of adaptation measures</li> <li>Fundamentals of the analysis of hydrometeorological and hydrological data</li> <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, plann methods</li> <li>Consideration of complex tasks</li> </ul>
<b>Personal Competence</b> Social Competence Autonomy	<ul> <li>Working in heterogenous groups</li> <li>Working with different scientific / non-scientific disciplines</li> <li>Self reflection</li> <li>Application oriented use of knowledge and skills</li> </ul>
	Autonomous work on complex tasks
	Independent Study Time 124, Study Time in Lecture 56
Credit points	
Course achievement	
Examination Examination duration and scale	Written elaboration Preparation of a written report and a presentation of a complex task.
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: Elective Compulsory
Following Curricula	Civil Engineering: Specialisation Geotechnical Engineering: Elective Compulsory
	Civil Engineering: Specialisation Structural Engineering: Elective Compulsory
	Civil Engineering: Specialisation Water and Traffic: Elective Compulsory
	Water and Environmental Engineering: Specialisation Cities: Elective Compulsory
	Water and Environmental Engineering: Specialisation Environment: Elective Compulsory

Course L2291: Adaptation to	o climate change in hydraulic engineering
Тур	Project-/problem-based Learning
Hrs/wk	4
СР	6
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56
Lecturer	Prof. Peter Fröhle
Language	DE
Cycle	WiSe
Content	<ul> <li>Climate protection and climate adaptation</li> <li>Findings on climate change and its regional characteristics: fundamentals of climate change, climate modelling / climate models</li> <li>Impacts of climate change on the components of the regional hydrological cycle(climate science view)</li> <li>Fundamentals of the analysis of climate data</li> <li>Concequences of the impacts of climate change (ingenieering science view)</li> <li>Measures for climate change adaptation</li> <li>Assessment, prioritization and communication of measures</li> <li>Fundamentals of analysis of hydrometeorological and hydrological data</li> </ul>
Literature	Bereitgestellte eLearning Plattform

## Module M0969: Selected Topics in Civil Engineering

Courses				
Title		Тур	Hrs/wk	СР
Ergonomics (L0653)		Lecture	2	3
Construction robotics (L0708)		Project-/problem-based Learning	3	3
Analysis of Offshore Structures (L18	867)	Lecture	1	1
Excellence in International Project I	Delivery (L2387)	Integrated Lecture	2	2
Design of Prefabricated Concrete S	tructures (L0596)	Lecture	1	1
Design of Prefabricated Concrete S	tructures (L0597)	Recitation Section (large)	1	1
Forum I - Geotechnics and Construe	ction Management (L1634)	Seminar	1	1
Forum II - Geotechnics and Constru	ction Management (L1635)	Seminar	1	1
Geotechnical Engineering Design (I	_2447)	Lecture	2	3
Timber Structures (L1151)		Seminar	2	2
Innovative Timber Construction (L2	666)	Lecture	2	3
Glass Structures (L1152)		Lecture	2	2
Glass Structures (L1447)		Recitation Section (large)	1	1
Testing and non-destructive examined	nation of concrete members (L2725)	Project-/problem-based Learning	2	2
Special topics of civil engineering 1	CP (L2378)		1	1
Special topics of civil engineering 2			2	2
Special topics of civil engineering 3	3 LP (L2380)		3	3
Structural Design (L2789)		Seminar	2	2
Module Responsible	Prof. Frank Schmidt-Döhl			
Admission Requirements	None			
<b>Recommended Previous</b>	none			
Knowledge				
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 through set</li> </ul>	lected special areas within civil and structur	al engineering	g.
	<ul> <li>Students are able to explain basic models and</li> </ul>	l procedures in selected special areas of civi	l and structur	al engineering.
	<ul> <li>Students are able to interrelate scientific and the scientific and the scientific and the science of the science</li></ul>	technical knowledge.		
Skills	<ul> <li>Students are able to apply basic methods in set</li> </ul>	elected areas of civil and structural enginee	ring.	
		5	5	
Personal Competence				
Social Competence				
Autonomy				
	<ul> <li>Students can chose independently, in which f</li> </ul>	fields they want to deepen their knowledge	e and skills th	rough the election
	courses.			
	Depends on choice of courses			
Credit points	6			
		ng: Elective Compulsory		
Credit points	6 Civil Engineering: Specialisation Structural Engineerin	•		
Credit points Assignment for the	6 Civil Engineering: Specialisation Structural Engineerin	ering: Elective Compulsory		

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

Course L0708: Construction robotics		
Тур	Project-/problem-based Learning	
Hrs/wk	3	
СР	3	
Workload in Hours	Independent Study Time 48, Study Time in Lecture 42	
Examination Form	Mündliche Prüfung	
Examination duration and	15 min	
scale		
Lecturer	Francisco Williams Riquer	
Language	DE	
Cycle	WiSe	
Content	The students learn in the lecture the required knowledge in control systems to apply it to a specific project-based geotechnical problem. In a two-weeks time frame, students can test developed control strategies in the lab and present their results. At the end of the lecture, students will have an oral examination.	
Literature	Ogata, Katsuhiko. Modern control engineering. Vol. 5. Upper Saddle River, NJ: Prentice hall, 2010. Ross, Timothy J. Fuzzy logic with engineering applications. John Wiley & Sons, 2005.	

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

Course L2387: Excellence in International Project Delivery		
	Integrated Lecture	
Hrs/wk	2	
CP	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Klausur	
Examination duration and	2 h	
scale		
Lecturer	Dr. Jens Huckfeldt	
Language	EN	
Cycle	SoSe	
Content	Simply and easy to avoid mistake in project delivery can deliver projects within budget and as per schedule.You	
	have to attend if you see yourself in project execution and potentially even abroad.	
Literature		

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

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

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

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

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

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

Course L2666: Innovative Timber Construction		
Тур	Lecture	
Hrs/wk	2	
СР	3	
Workload in Hours	Independent Study Time 62, Study Time in Lecture 28	
Examination Form	Schriftliche Ausarbeitung	
Examination duration and	45 Minuten	
scale		
Lecturer	Dr. Andreas Meisel	
Language	DE	
Cycle	WiSe	
Content		
Literature	- Blass, J.: "Ingenieurholzbau"	
	- Schickhofer, G.: "BSPhandbuch: Holz-Massivbauweise in Brettsperrholz"	
	- Informationsdienst Holz: div. Merkblätter und Broschüren	
	- Wallner-Novak M.: Brettsperrholz Bemessung, Band 1 und 2	
	- Gerner M.: "Fachwerk: Entwicklung, Instandsetzung, Neubau"	
	- Meisel, A.: "Historische Dachwerke: Beurteilung, realitätsnahe statische Analyse und Instandsetzung"	
	- Kempe K.: "Dokumentation Holzschädlinge"	
	- Huckfeldt T.: "Hausfäule- und Bauholzpilze"	

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

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

Course L2725: Testing and non-destructive examination of concrete members		
Тур	Project-/problem-based Learning	
Hrs/wk	2	
СР	2	
Workload in Hours	Independent Study Time 32, Study Time in Lecture 28	
Examination Form	Mündliche Prüfung	
Examination duration and	20 min	
scale		
Lecturer	Dr. Lukas Henze, Dr. Lukas Henze	
Language	DE	
Cycle	SoSe	
Content		
Literature		

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

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

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

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

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

Courses				
Title		Тур	Hrs/wk	СР
Sustainable Nature-based Coastal	Protection in a Changing Climate (SeaPiaC) (L2926)	Project-/problem-based Learning	4	6
Module Responsible	Prof. Peter Fröhle			
Admission Requirements	None			
<b>Recommended Previous</b>				
Knowledge				
	Hydromechanics, Hydraulics     Eurodemontals of Coastal Engineering, Coastal as	ad Eland Protoction		
	<ul> <li>Fundamentals of Coastal Engineering, Coastal- and</li> </ul>			
Educational Objectives	After taking part successfully, students have reached th	e following learning results		
Professional Competence				
Knowledge	Climate and Climate Change			
	Climate and Climate Change     Constant Strength of Climate Change	me and Water Curls		
	<ul> <li>General Impacts of Climate Change on Wind Regi</li> <li>Consequences of Climate Change for Coastal Pro</li> </ul>			
	<ul> <li>Consequences of climate change for coastal Protection in Taiwan and Germany</li> </ul>			
	Fundamentals of Climate Adaptation			
	Nature-based Solutions (NBS) for Coastal Protection	on		
Skills	<ul> <li>Critical thinking: analysis of processes and relation</li> </ul>	ons, assessment of needs for action		
	<ul> <li>Creative thinking: development of adaptation stra</li> </ul>			
	<ul> <li>Practical thinking: inclusion of restrictions, app</li> </ul>		nods, numeric	al models, plannir
	methods			
	Consideration of complex tasks			
Devenuel Compotence				
Personal Competence Social Competence				
Social Competence	Working in heterogenous groups			
	<ul> <li>Working in international groups</li> </ul>			
	Working with different scientific / non-scientific d	sciplines		
	Self reflection			
Autonomy				
, aconomy	Application oriented use of knowledge and skills			
	Autonomous work on complex tasks			
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56			
Credit points				
Course achievement	None			
Examination	Written elaboration			
Examination duration and	Preparation of a written report on a complex task with	a presentation and subsequent discussion	on. The work	on the complex ta
scale	happens in the course of the lecture.			
Assignment for the	Civil Engineering: Specialisation Coastal Engineering: El	ective Compulsory		
Following Curricula				
	Civil Engineering: Specialisation Structural Engineering:			
	Civil Engineering: Specialisation Water and Traffic: Elect			
	Water and Environmental Engineering: Specialisation Ci			
	Water and Environmental Engineering: Specialisation Er			
	Water and Environmental Engineering: Specialisation W	ater: Elective Compulsory		

Course L2926: Sustainable N	ourse L2926: Sustainable Nature-based Coastal Protection in a Changing Climate (SeaPiaC)		
Тур	roject-/problem-based Learning		
Hrs/wk			
CP	6		
Workload in Hours	Independent Study Time 124, Study Time in Lecture 56		
Lecturer	Prof. Peter Fröhle		
Language	EN		
Cycle	WiSe		
Content	<ul> <li>Climate and Climate Change</li> <li>General Impacts of Climate Change on Wind Regime and Water Cycle</li> <li>Consequences of Climate Change for Coastal Processes</li> <li>Coastal Protection in Taiwan and Germany</li> <li>Fundamentals of Climate Adaptation</li> <li>Nature-Based Solutions (NBS) for Coastal Protection</li> </ul>		
Literature	Materials provided on eLearning Platform (HOOU Platform)		

Thesis Module M-002: Master Thesis		
Courses		
Title	Typ Hrs/wk CP	
Module Responsible	Professoren der TUHH	
Admission Requirements	According to General Regulations §21 (1):	
	At least 60 credit points have to be achieved in study programme. The examinations board decides on exceptions.	
Recommended Previous Knowledge		
Educational Objectives	After taking part successfully, students have reached the following learning results	
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 terminologies in one or more areas of their subject describing current developments and taking up a critical position on them.</li> </ul>	
	<ul> <li>The students can place a research task in their subject area in its context and describe and critically assess the state research.</li> </ul>	
Skills	The students are able:	
	<ul> <li>To select, apply and, if necessary, develop further methods that are suitable for solving the specialized problem in questio</li> <li>To apply knowledge they have acquired and methods they have learnt in the course of their studies to complex and/ incompletely defined problems in a solution-oriented way.</li> <li>To develop new scientific findings in their subject area and subject them to a critical assessment.</li> </ul>	
Personal Competence		
Social Competence	Students can	
	<ul> <li>Both in writing and orally outline a scientific issue for an expert audience accurately, understandably and in a structur way.</li> <li>Deal with issues competently in an expert discussion and answer them in a manner that is appropriate to the addresse while upholding their own assessments and viewpoints convincingly.</li> </ul>	
Autonomy	Ctudents are able.	
Autonomy	Students are able:	
	<ul> <li>To structure a project of their own in work packages and to work them off accordingly.</li> <li>To work their way in depth into a largely unknown subject and to access the information required for them to do so.</li> <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		
Examination		
	According to General Regulations	
scale		
-	Civil Engineering: Thesis: Compulsory	
Following Curricula	Bioprocess Engineering: Thesis: Compulsory Chemical and Bioprocess Engineering: Thesis: Compulsory	
	Computer Science: Thesis: Compulsory	
	Electrical Engineering: Thesis: Compulsory	
	Energy Systems: Thesis: Compulsory	
	Environmental Engineering: Thesis: Compulsory	
	Aircraft Systems Engineering: Thesis: Compulsory	
	Global Innovation Management: Thesis: Compulsory	
	Computer Science in Engineering: Thesis: Compulsory	
	Information and Communication Systems: Thesis: Compulsory	
	Interdisciplinary Mathematics: Thesis: Compulsory International Production Management: Thesis: Compulsory	
	International Management and Engineering: Thesis: Compulsory	
	Joint European Master in Environmental Studies - Cities and Sustainability: Thesis: Compulsory	
	Logistics, Infrastructure and Mobility: Thesis: Compulsory	
	Materials Science: Thesis: Compulsory	
	Mechanical Engineering and Management: Thesis: Compulsory	
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## Module Manual M.Sc. "Civil Engineering"

	Mechatronics: Thesis: Compulsory
	Biomedical Engineering: Thesis: Compulsory
	Microelectronics and Microsystems: Thesis: Compulsory
	Product Development, Materials and Production: Thesis: Compulsory
	Renewable Energies: Thesis: Compulsory
	Naval Architecture and Ocean Engineering: Thesis: Compulsory
	Ship and Offshore Technology: Thesis: Compulsory
	Teilstudiengang Lehramt Metalltechnik: Thesis: Compulsory
	Theoretical Mechanical Engineering: Thesis: Compulsory
	Process Engineering: Thesis: Compulsory
	Water and Environmental Engineering: Thesis: Compulsory
	Certification in Engineering & Advisory in Aviation: Thesis: Compulsory